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ELECTRICAL REVIEW

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22 APRIL 1955

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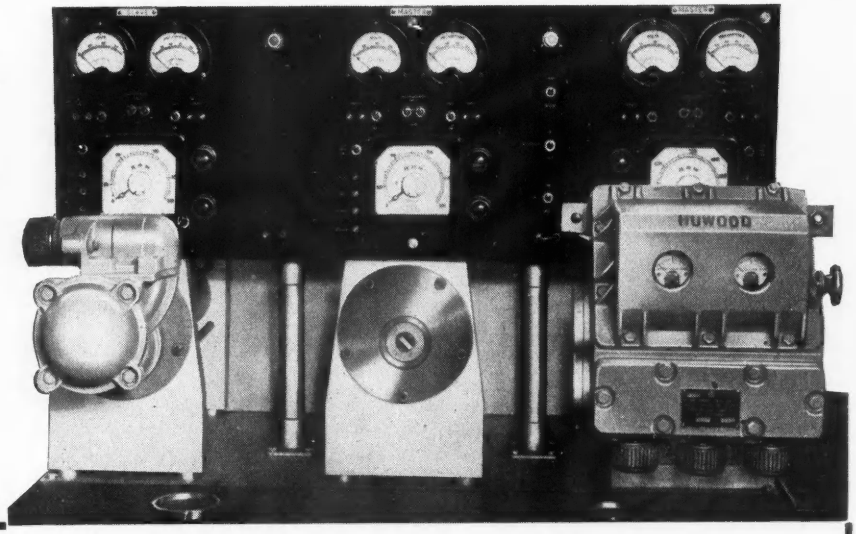
Spearhead to the Coal Drive



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The above illustration shows automatic conveyor sequencing and belt protective equipment on test at the works of Messrs. Hugh Wood & Co. Ltd., Gateshead 11.

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The voltmeters and ammeters at the top indicate the outputs of the generators under test, whilst the three speed indicators below are operated from tachometers coupled to variable speed A.C. motors.

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ELECTRICAL REVIEW

22 April 1955 Vol. 156 No. 16 Established 1872

Management Within Engineering

FOR a long time it has been increasingly apparent that certain aspects of engineering are managerial functions, and we think that this applies particularly to electrical engineering. This rather new outlook of management within engineering finds expression in " The Practical Training of Professional Electrical Engineers "—the report of a Committee appointed by the Council of the British Electrical and Allied Manufacturers' Association, the Radio Industry Council and the Council of the Institution of Electrical Engineers — and that outlook is emphasized by the definitions given of an electrical technician and a professional electrical engineer. An electrical technician is " one who is qualified by specialized technical education and intensive practical training to carry out responsible work involving the making of decisions in accordance with established practice whilst under the general direction of professional electrical engineers." A professional electrical engineer is " one who by virtue of his general and technical education, practical training and subsequent experience is fitted to undertake work requiring a high degree of personal responsibility in one or more of the branches of electrical engineering."

The implication of management in the second of these definitions must, we think, have been part of the background of the speech of Mr. J. Eccles, C.B.E., B.Sc., President of the Institution of Electrical Engineers, at the annual dinner of the Institution on 24th February, reported in the *Electrical Review* of 4th March, when he concluded that the learned Institutions could not concur in any proposal which might create a crop of sub-standard young men who, though classing themselves as engineers, might not qualify for membership.

The " management within engineering " idea can also be detected, we think, in the incorporation of the Institute of Industrial Administration in the British Institute of Management, with the retention of the identification of the Institute of Industrial Administration for professional qualification purposes. Certainly the names of eminent engineers are increasingly appearing in the I.I.A. list of members. But perhaps this line-up between engineering and management is more definitely marked in the production engineering field, where the planning involves a careful collection of data regarding the machines employed, the processing of the material, the operation times, the distances travelled by workpieces and the time occupied in transport, the time taken for inspection, the delays that arise at the machines while waiting for operations to commence and the times which elapse when the component is in storage. The collection and collation of all this information and its marshalling for study to find the best possible balance of machine utilization are both engineering and management of a high order.

Now the trend is marked in a special manner by an announcement by the Cambridge University of the decision to appoint a Reader in the Department of Engineering who will be expected " to develop teaching and research in industrial management in so far as the study of the subject is related to the study of engineering on the one hand and to the study of economic and industrial psychology on the other hand."

METER TESTING

"It is clearly wasteful to give a tester an accurate and rapid testing device if he is going to spend longer setting it up and in interpreting the results than in the actual testing." This seems to be the keynote of the article "Modern Meter Testing" by Mr. H. S. Petch in this issue. The article traces the development in bulk meter testing following the 1936 Meters Act and indicates the necessity of speeding up the methods employed in such testing. The author points to the stroboscopic method of disc counting and shows how an improvement as high as 400 per cent has been obtained in a complete intermediate size testing station. The methods described place great reliance on the sub-standard instrument which must therefore be checked frequently; but the author shows how the insertion of a wattmeter in the equipment allows check testing under the time control of the station master clock. Where these newer testing methods have been employed the testing engineers have "in a very short time entered into the enjoyment of using a markedly better tool and have begun to see just what are the maximum results they can get out of it."

"ESTABLISHED PRACTICE"

In our report on staff suggestions in the electricity supply industry on page 689 of this issue we mention the adoption of a suggestion (to abolish neutral links on meter boards) so simple that one wonders why no one had previously challenged established practice and produced through all grades of authority the dictum that no reason for retention could be found. In this particular case the district assessor expected a saving of between £500 and £1,000 a year as a result. Presumably on a national scale the saving would be far greater. One wonders how many economies could be made if only all of our "established practices" could be examined in a completely disinterested manner; how much material could be saved; how many hours gained. Not only in our own industry but in others too the scope is very wide and it is good to see the spread of suggestions schemes with worthwhile rewards for worthwhile suggestions.

COLLIERY UNDERGROUND LIGHTING

In the final article of our short series on "Electricity in Coal Mining" in this issue, Mr. D. A. Strachan shows the very considerable advance that has been made in recent years in underground lighting against a background of exceptional difficulties. These difficulties are in the main similar to those which restrict advancing face and by their necessarily low mounting equipment in all other fields covered by the series, particularly face operation and underground haulage; they are brought about by restrictions imposed by essential official regulations consequent upon exceptional hazards. It is for this reason that the author says that standards for underground lighting must not be compared on the same basis as those accepted for surface installation. Mr. Strachan's article leads off with the impression that the two fields underground which offer the greatest opportunities for advancement in electric lighting are, first, coal face lighting, in which case particular difficulties are presented by the advancing face and by their necessarily low mounting heights which make it hard to achieve uniform illumination at the working surface; and, secondly, road lighting for which there appears to be an economic case for non-continuous lighting, in view of the likely large-scale future use of locomotive haulage, although track maintenance may necessitate continuous lighting.

SUBMARINE POWER CABLES

The magnitude of the contribution made by electrical manufacturers towards British exports is illustrated by the 77 miles of 138 kV cable ordered for under-sea power transmission near Vancouver. This, as mentioned elsewhere in this issue, was the largest single order from Canada last year. The cable is of the pre-impregnated gas-filled type employed in the sea trials for the suggested Dover-Calais connection. No doubt the success achieved by the cable makers and the experience they gained in this way considerably influenced the purchasers. An outstanding feature of the chosen design is that, since the paper-dielectric is impregnated before application, the length of its sections is not limited by the size of impregnating tanks, thus greatly reducing the number of joints to be laid at sea.

GAS INDUSTRY RATES

Apart from procedural changes relating to the publication of valuation lists, the Rating and Valuation (Miscellaneous Provisions) Bill, the debate on which was reported in our last issue, provides for a new method of computing the rates payable by Gas Boards in England and Wales. Each Board will be rated on a notional hereditament (instead of on the individual properties occupied), varied annually according to the Board's sales of gas apportioned among rating areas by reference to the quantities of gas supplied and manufactured in each area. This is to apply retrospectively to 1st April, 1952. The system differs from that applicable to electricity supply in that there will be an allocation of rateable value to each of the rating authorities and not of sums payable in lieu of rates; also gas manufacture is taken into account. The proposals are of concern to the electricity supply industry in view of possible changes implied in the announcement that there is to be a general review of the provisions of Part V of the Local Government Act, 1948, which governs payments in lieu of rates by the Central Electricity Authority and the British Transport Commission.

Guide to B.I.F.

The British Industries Fair is being held at Olympia (London) and Birmingham from 2nd to 13th May. Next week's issue of the "Electrical Review" will contain a complete guide to the electrical exhibits

Modern Meter Testing

A Solution to Some of the Problems Involved

By H. S. PETCH, B.Sc.(Eng.), M.I.E.E., M.Amer.I.E.E.*

THIS article deals with the testing of single phase meters from the viewpoint of an electricity supply authority. The problems considered have a basis of economics, but this should not be taken as suggesting that there are no unsolved technical problems in testing either single phase, polyphase or d.c. meters.

The 1947 Act enjoins a search for efficiency and economy, and a first step in that direction was, where geography permitted, to replace a number of small testing stations by larger units, a process facilitated by the larger groupings brought about by the same Act. Large and efficient testing stations were, of course, not by any means unknown before 1947, but it seemed proper not simply to adopt existing methods without question, but to study all possibilities, in an endeavour to secure the highest attainable output per person employed in the testing station.

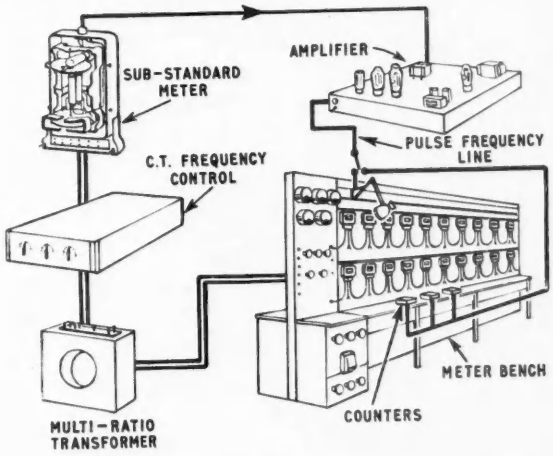


Fig. 1.—Schematic layout of a high-speed meter testing equipment

Governed as it is by the 1936 Meters Act regulations, a meter testing station must still subject all meters offered for certification to an electrical dial test on at least one load. This fact controls the pattern of the whole testing procedure, since to meet the requirement there appears no reasonable alternative to the series connection of batches of meters. Once having meters so connected, it seems logical to use the same dial-test method for all test loads, except when the mandatory duration of test runs becomes uneconomically long, when a rotor speed checking method is to be preferred. All this was well known, commonly used, and still satisfactory for checking new meters, where the need for any adjustment should be exceptional.

The testing of large numbers of repaired meters brought in an additional factor, however, because adjustment would now be the rule, and in nearly all cases a meter testing station would have to deal with an inheritance of meters having the whole gamut of ratings and speeds. The basic need seemed to be for a quick means of " pulling-in " repaired meters precise enough to be sure that when subsequently dial-tested, the accuracy at all test loads would be acceptable without further attention.

The adjustment methods in current use were examined, but none of them appeared fully to meet the need, being either wasteful of expensive man-power, lacking in possible accuracy, over-dependent on the human factor, not easily adaptable to a wide variety of meter speeds, or requiring a number of expensive substandards. The most promising device was the stroboscope, as it permitted adjustment " by inspection," and so minimized the time spent on each meter. This device was in use by many manufacturers for " pulling-in " but as they each dealt with a single product, they did not have the speed range problem.

Attention was therefore concentrated on adapting the stroboscope to fit the requirements, and the arrangement finally adopted consists essentially of illuminating the suitably marked discs of the meters to be adjusted with a flashing light, the rate of flash being derived photo-electrically from a rotating substandard meter which is connected via a multi-ratio current transformer in series with the meters being adjusted The multi-ratio transformer provides the " variable gear box " to cover the wide speed range (see Fig. 1).

Originally, a triggered photo-flash tube was used as a source of strobing light, and it gave a beautifully sharp image, but the arrangement was found to have an uneconomic life. The pulses from the substandard were therefore rounded off to approximate to a sine wave and it was found that some commercial synchronous motors would then keep in step over the required speed range. A synchronous shutter at the focus of a small projector system then gave a sufficiently bright and short flashing

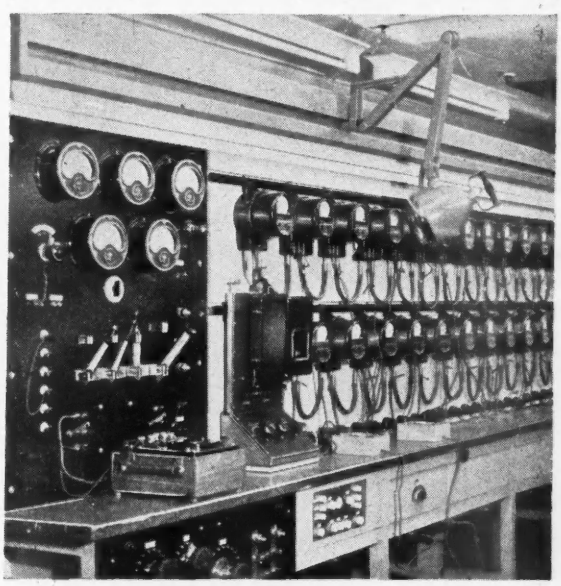


Fig. 2.—Pilot equipment for high-speed meter testing

* Mr. Petch is Meter and Testing Engineer, London Electricity Board.

spot of light, and this arrangement continues in use. It appears to have advantages over arrangements which use the general illumination as a strobing light, in that it seems to impose no eye-strain in continuous use, because virtually none of the background is involved in the flicker.

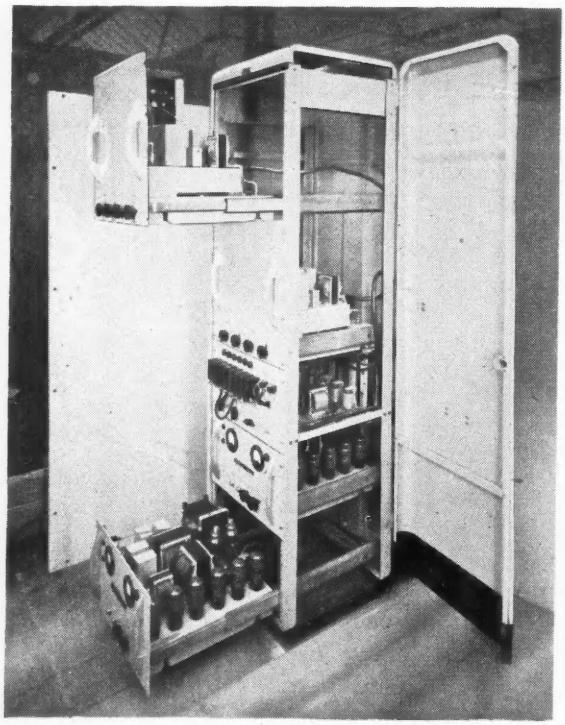
It had, of course, been realized from the outset that the stroboscope would be unsuited to low load adjustment, because of low flash speed, and cyclic speed variation in the meters on test. One solution to this was to count in some way the substandard pulses during one or two revolutions of the meters on test. Having been able to use synchronous motors at the pulse frequency, the basis of one suitable counter was obvious. It was found that a tester could, without difficulty, control six such counters at low loads, thus effectively reducing the low load test time to one-third of a revolution or less. Since the counters (see Fig. 4) could be regarded as extensions of the substandard meter dials, they could clearly be used for tests at any loads and so become a satisfactory means of final accuracy measurement at those loads where dial testing was inconvenient.

Counter and Dial Test Results Compared

A pilot equipment embodying the foregoing principles (see Fig. 2) was set up and given exhaustive trials, which it passed triumphantly. In this period one enthusiastic tester tested 750 meters single-handed in one week. A very large number of comparisons were then made between the errors of meters finally tested by the counters and of the same meters checked by dial test. The agreement was so good that the Chief Meter Examiner agreed to accept the slave counter method as a suitable test for meters offered for certification.

A complete intermediate-size testing station was then equipped, and comparisons were made between its testing productivity and those of other stations using older methods. An improvement of the order of 400 per cent was obtained.

Fig. 3.—Example of a commercially produced duplex control equipment



Commercially produced apparatus using the same principles is therefore being adopted as standard for the large testing stations now being set up. The design has been arranged so that the additional equipment (see Fig. 3) required by the method can be added into an existing arrangement of test benches and meter racks, with little disturbance except for wiring. In this way, much existing gear has been used, even on new sites.

When one sets out to seek the ultimate in any process, it is all too easy to find one's efforts defeated by secondary matters whose significance becomes relatively greater, but which are only revealed as the main process speeds up. For this reason, a number of points have needed study in the present case.

It is clearly wasteful to give a tester an accurate and rapid testing device if he is going to spend longer in setting it up and in interpreting the results than in the actual testing. For this reason, a series of instruction cards (see Tables I, II and III) have been prepared for each of the kinds and sizes of meters to be tested, each of which lists all the settings to be used, and gives the appropriate gear box ratios, i.e., the proper ratios of the multi-ratio current transformer, which is controlled by a set of decade dials. When the counters are in use, the constants are so chosen that for a correct meter the counter reading will be 1,000 precisely (see Fig. 4). In this way the errors of meters can be written down directly by inspection. To do this, of course, any corrections to be made for substandard errors must be allowed for when setting the decade dials and corrections are therefore kept up to date on the instruction cards.

Certain older meters have inherent curves such that adjustment at particular loads must be aimed at a definite fast or slow error rather than at zero error. This is provided for on the relevant instruction cards by a " curve allowance " made to the settings of the decade dials.

Stroboscope adjustment can only be done with meter covers removed, and many metal-cased meters still come in for repair. A number of cover-off/cover-on tests were made, and an average correction for each variety of meter concerned was found. These corrections are also allowed for in the setting up of the decade dials as shown by the instruction cards. The variation from average behaviour has been found to be small enough to ensure that, adjusted in this way, the bulk of metal-cased meters when later tested " cover-on," as they must be, are within satisfactory limits.

The method places great reliance on the substandard. This must therefore be checked frequently for stability, and means have been built into the equipment so that the insertion of a wattmeter allows of a check test under the time control of the station master clock. The whole apparatus is included in the check test, and the substandard errors can be read on the counter dials. Check test con-

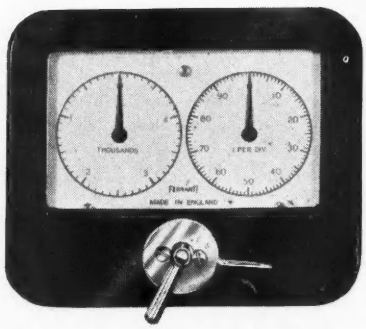


Fig. 4.—Synchronous motor-driven counter

ditions are set up by switching, so as to minimize the time during which the apparatus is kept out of productive use.

The counter method of test and stroboscope adjustment are basically speed comparisons between two watthour meters. The substandard, however, is always used at a fairly high speed. Accordingly, it cannot be assumed that external effects such as voltage, frequency, and temperature will equally affect substandard and meter under test, even if their characteristics happen to be similar. The substandard was therefore chosen to be as error-free as possible under all reasonable conditions. It remains to be investigated as to whether a stabilized non-mains supply would make any economically justifiable improvement in the level of test results, or in the rate of working, but this is thought unlikely.

A failure in the photo-electric and associated amplifying gear could cause a serious production hold-up, so that duplicated equipment is provided, connected by plugs and jacks. A faulty component can then be taken right away for overhaul, thus avoiding a disturbing element in the test room.

A criticism of some earlier optical testing devices is that they must be precisely lined up on the meter under test, which can be time-consuming. This was avoided by mounting the stroboscope lamp head on an adjustable arm, itself fixed to a small trolley on rails along the top of the existing test racks (see Fig. 2). It was found that the testers' rate of work was considerably affected by their confidence in the stroboscope, and this in turn was much improved if the disc marking was uniform and unbroken, and the marks themselves fairly thin, and concentric. Accordingly the discs of repaired meters are marked from a die by the gelatin pad transfer method, and which, used with a small drying oven, has been found quick and satisfactory.

Although the method is quite capable of dealing with a mixed batch of meters, it will obviously yield its best performance if all meters in a batch are alike. This has influenced the manner of working in the repair shops and has produced a need for somewhat extended storage space for off-circuit meters so that "marshalling" is facilitated.

It has also been found by experience to be psychologically better to give each tester a batch of meters each day which he can reasonably be expected to finish off in that day, as any carry-over tends automatically to

TABLE I.—INSTRUCTION CARD FOR METER WITH NO CORRECTIONS

240 Revs per Unit											200 Lines
Amps 25			Volts 220			Make L. & G.			Type CF3 & CF6		
1	2	3	4	5	6	7	8	9	10	11	12
			Stroboscope		Counter						
		Load	Meter	Nom'l. Sett'g.	Meter	Nom'l. Sett'g.	Allowances		Actual Setting		Meter
% F.L.	P.F.	A.L. Range	S/Std.		S/Std.		Cover	Curve	Strob.	Counter	Counter
100	1·0	25/25	2·727/2·727	200	As	Strob.	—	—	200	200	20/1000
100	0·5	25/25	5·454/5·454	200	As	Strob.	—	—	200	200	20/1000
50	1·0	12·5/25	5·454/5·454	200	As	Strob.	—	—	200	200	20/1000
5	1·0	1·25/2·5	—	—	54·54/2·727	100	—	—	—	100	1/1000
Remarks.									Cols. 10 and 11. Adjustment Settings. Col. 7. Final Test Setting.		

TABLE II.—INSTRUCTION CARD FOR SLOW SPEED METER WITH CURVE AND COVER CORRECTION

65·45 Revs per Unit											200 Lines
Amps 50			Volts 220			Make Ferranti			Type FCC		
1	2	3	4	5	6	7	8	9	10	11	12
			Stroboscope		Counter						
		Load	Meter	Nom'l. Sett'g.	Meter	Nom'l. Sett'g.	Allowances		Actual Setting		Meter
% F.L.	P.F.	A.L. Range	S/Std.		S/Std.		Cover	Curve	Strob.	Counter	Counter
100	1·0	50/50	5·000/5·000	366·6	As	Strob.	2·5+	—	375/1	375/1	20/1000
100	0·5	50/50	10·00/5·000	183·3	As	Strob.	2·5+	0·5+	188/2	188/2	10/1000
50	1·0	25/50	10·00/5·000	183·3	As	Strob.	2·5+	—	187/2	187/2	10/1000
5	1·0	2·5/2·5	—	—	100·0/5·000	366·6	2·5+	0·5+	—	377/1	1/1000
Remarks.—See General Notes.									Cols. 10 and 11. Adjustment Settings. Col. 7. Final Test Setting.		

TABLE III.—INSTRUCTION CARD FOR FAST SPEED METER WITH CURVE AND COVER CORRECTIONS

600 Revs per Unit											200 Lines
Amps 20			Volts 220			Make C. & H.			Type AI		
1	2	3	4	5	6	7	8	9	10	11	12
			Stroboscope		Counter						
		Load	Meter	Nom'l. Sett'g.	Meter	Nom'l. Sett'g.	Allowances		Actual Setting		Meter
% F.L.	P.F.	A.L. Range	S/Std.		S/Std.		Cover	Curve	Strob.	Counter	Counter
100	1·0	20/25	1·364/2·727	160	As	Strob.	1·0+	0·5+	162/1	162/1	40/1000
100	0·5	20/25	2·727/2·727	80	As	Strob.	1·0+	—	80/5	80/5	20/1000
50	1·0	10/25	2·727/2·727	80	As	Strob.	1·0+	0·5—	80/2	80/2	20/1000
5	1·0	1·0/2·5	—	—	27·27/2·727	80	1·0+	0·5+	—	81/1	2/1000
5	1·0	1·0/1·0	—	—	27·27/2·727	200	1·0+	0·5+	—	203	2/1000
Remarks.—See General Notes.									Cols. 10 and 11. Adjustment Settings. Col. 7. Final Test Setting.		

become two days' work. It has been found better to let each tester adjust and test his own complete batch of meters.

The criticism has been levelled at the arrangements outlined that they have taken the interest out of meter testing. A similar argument was probably used against the first man who used a wheel barrow, but experience has followed the pattern of history in demonstrating the criticism to be unjustified. Three separate testing groups, faced with changing over to these faster methods have first exhibited expected natural reactions, but in a very short time have entered into the enjoyment of using a markedly better tool, and have begun to see just what are the maximum results they can get out of it.

There are still some points where trimming of the time spent per meter is possible. It still takes too long to connect meters for test, to seal them after test, and to do the presently unavoidable clerical work. It is capable of argument that at least in the case of modern meters, an electrical dial-test is economically unjustified.

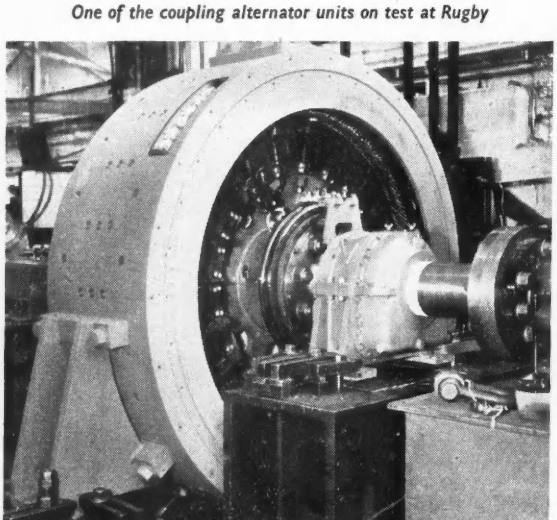
Electro-Magnetic Coupling Alternators

IN the bulk-cargo type of vessel equipped with electrically driven self-discharging cargo handling machinery the auxiliary generating sets necessary to provide sufficient power may approach the same size as the propulsion machinery itself, and in vessels of, say, 1,000 to 3,000 tons deadweight, considerable difficulty has sometimes been encountered in arranging sufficient accommodation in the engine room. With such difficulties in mind, the British Thomson-Houston Co., Ltd., has developed the conventional electro-magnetic coupling so that in addition to operating as a normal coupling between the main engine and the propeller when the ship is at sea, it can also be used as an alternator, driven by the main engine, for supplying electric power when the ship is in port.

The first ship to be equipped with these newly developed coupling alternators is the 1,400-ton twin-screw bulk cargo ship M.V. *Golden Bay,* built by Henry Robb, Ltd., for the Tarakohe Shipping Company, Wellington, New Zealand, in conjunction with the Golden Bay Cement Company. In addition to the coupling alternators, the B.T.H. Co. supplied all the electric motors and control gear for the cargo handling equipment. The ship has a service speed of 10 knots and is powered by two British Polar Type M44M diesel engines each developing 630 b.h.p., transmitting power at 250 r.p.m. through the two electro-magnetic coupling alternators.

Each coupling alternator unit consists of inner and outer members with no mechanical connections between them; the inner member is coupled to the engine crankshaft through an intermediate stub shaft and sleeve bearing and the outer member is coupled directly to the propeller shafting. The inner member consists of a fabricated steel rim on which are mounted twenty electro-magnetic poles facing radially outwards. This rim is mounted on a fabricated steel spider with a spigotted flange for bolting to the intermediate stub shaft which, in turn, is coupled to the engine crankshaft. Excitation is supplied from the ship's auxiliary 220 V d.c. busbars through sliprings mounted on the coupling flange, the necessary brushgear being mounted on a bracket attached to the intermediate bearing pedestal.

One of the coupling alternator units on test at Rugby



The outer member consists of a fabricated disc and a steel outer rim carrying the laminations and a three-phase winding for the rotating field system on the inside of the rim. The windings consist of copper bars assembled in the slots of the laminated core and have Class "B" insulation impregnated to withstand tropical marine engine-room conditions. The winding is star-connected and while the units are being used as couplings, the phases are connected together to form a closed circuit acting as a squirrel-cage winding. Under this condition, power is transmitted from the engines to the propeller shafts with only a small reduction in speed, the slip being approximately 1½ per cent.

When in harbour and being used as alternators, the outer members are kept stationary by a steel wedge. The "shorting" links are removed and suitable connections are made to the three-phase windings of each outer member; the units can then be used as conventional alternators each driven by one of the main engines. Under such conditions the engines are run at 300 r.p.m. and the alternators develop 500 kW each at 440 V, three-phase, 50 c/s.

The field excitation of the coupling-alternator units is controlled by a hand wheel with star wheel location for the initial step. Moving the hand wheel to this position closes mechanically operated contactors by means of cams and applies excitation to the coupling. Further rotation in a clockwise direction increases the excitation. As these coupling alternators are not designed for manœuvring, the excitation must be applied before starting up the engines and interlocks are fitted on the engine controls to operate audible alarms should the excitation be applied with the engines running.

When the machines are operating as alternators, their output voltage is maintained between pre-set limits, irrespective of the total load, by connecting or disconnecting fixed steps of resistance in series with the alternator fields. These are switched in or out of circuit by contactors operated by relays supplied from current transformers. As the load current increases, the relays operate at predetermined current values and cut out the fixed steps of resistance to increase the excitation. Three such steps are provided and by this means the voltage is maintained between the safe operating limits being finally adjusted to 440 V when the load has reached a steady value.

No provision is made for paralleling the alternators, but the bus-section switch enables one alternator to feed both distribution boards and enable unloading to be carried out at a reduced rate, using one engine only should the other be out of commission because of overhaul. The circuit breakers and bus-section switch are interlocked with Castel key exchange to prevent paralleling of the alternators.

Auxiliary 220 V d.c. power is supplied by two 60/70 kW and one 30 kW B.T.H. generators driven by Russell Newbery engines.

Peak Load Cost Reduction

Private Generators Used for Peak Supply

By H. M. BARLOW*

THE problem of providing for short-term peak loads in electricity supply is one to which much attention has been given and it is therefore surprising that full advantage is still not taken in many cases of the opportunities available to alleviate the difficulties.

It is the purpose of this article to call attention to the possibilities in the use of generating plant installed by consumers on their own premises for the primary purpose of taking off the peaks of their load. The importance to the electricity authority of the highest possible load factor is reflected in the comparatively heavy charge made to consumers per kW of maximum demand.

The capitalized value of the authority's generating plant and distribution system represents a very substantial item in determining the cost per kWh supplied and the consumer is naturally called upon to pay at a much higher rate for short-term peak loads. It is to be expected therefore that if a consumer can substantially improve his load factor by local generation at peak periods, there is a good chance not only of saving himself money but also of helping the electricity supply authority. Such contributions to peak loads generated locally can often be conveniently isolated from the base load supplied from the authority's mains, so that no question of paralleling local generators with the mains need arise.

Experience in making this kind of provision for the electricity supply to University College, London, will be of interest. For the year 1952-53 the peak load was 1,130 kW, the total consumption of electrical energy was 2,200,000 kWh and the load factor was 22 per cent. Thus the average load throughout the year was only about 250 kW. The tariff offered by the electricity supply authority was £7 5s 10d per annum per kW of maximum demand plus 1d/kWh, over and above those kWh reckoned in the maximum demand charge.

The college installed a 300 kW diesel alternator set and by running this at peak periods on a part of the load which had been separated from the rest of the local distribution system, it was found that a substantial economy could be made. With the auxiliary generator giving 250 kW for 40 hours per week over the 10 weeks during which the peak loads occurred, the cost of this supplementary source of power worked out at 3·26d/kWh, including interest on capital, depreciation and all running charges. The period of time over which peak loads actually extend is often remarkably short.

The net result of using the auxiliary generator was a saving in the cost of electricity consumed by the college of about £1,000 per annum, and had a larger plant been available a still better result could have been achieved. Moreover, the equipment formed a valuable stand-by for use in emergency power cuts and the waste heat from the diesel engine might well have been applied, had suitable arrangements been made, to raising the temperature of water for a boiler feed or for domestic purposes. Detailed examination of the figures given shows that owing to the heavy burden of the maximum demand charge, which is equivalent to 5d/kWh, any auxiliary generating plant run at an overall cost not exceeding 4½d/kWh and applied in such a way as to reduce that maximum demand of 1,130 kW towards the average load of 250 kW will save money. This can easily be achieved at the present day prices of plant, fuel and labour.

For consumers to attempt to generate economically the whole of their electricity supply is a much more difficult undertaking. There are therefore indisputable benefits to be derived from local generation by auxiliary plant in the way described and these benefits extend also to the supply authority in the more effective use of its resources. There is no doubt that many consumers now taking the whole of their supply from the electricity authority would do well both in their own and in the national interest to consider the use of auxiliary generation for peak loads.

Acknowledgment is made to the Provost of University College for permission to publish the figures given.

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Electroluminescence

AT a meeting of the Illuminating Engineering Society on 19th April, Messrs. J. N. Bowtell and H. C. Bate discussed the possible field for electroluminescence, the production of light continuously from a phosphor (fluorescent powder) through the direct action of an a.c. field, as originally proposed by Destrian in 1936.

Electroluminescent light sources could be made, the authors stated, by incorporating the phosphor in a thin resin between two conducting plates to form a capacitor. One plate comprised a transparent conducting film on a glass sheet and the other a metallic film. At 240 V 50 c/s the brightness was 1 ft-lambert and the efficiency 2 to 3 lumens/W, using green panels; at 600 V the brightness was 3 to 5 ft-lamberts. A life of several thousand hours was obtainable, but lumen maintenance was at present inferior to that of conventional light sources. Brightness increased markedly with frequency, 50 ft-lamberts having been obtained.

It seemed unlikely that electroluminescent devices would be used as conventional light sources in the near future owing to their relatively low luminous efficiency and brightness. They were, however, finding applications in certain specialized fields such as safe-lights in photographic dark rooms, direction signs, obstruction markers and low power lamps. The use of electroluminescent devices had been proposed for lighting instrument dials, particularly for aircraft, where space was limited, and for image intensifiers in television.

NEW BOOKS

Linear Transient Analysis, Vol. 1. By Ernst Weber. Pp. 313; figs. Chapman & Hall, Ltd., 37, Essex Street, London, W.C.2. Price 60s in the United Kingdom.

The methods used to analyse the transient performance of electrical networks are now well formulated and widely known. This book reviews and presents these methods in an orderly fashion and is essentially a textbook on the transient analysis of two-terminal networks composed of lumped linear parameters.

The assumptions which are made in electromagnetic field phenomena so that they may be represented by lumped parameters are outlined in chapter one. The formulation of a circuit to analyse is often as difficult as the analysis itself. Integro-differential equations form the basis of the classical solution of transients and these are reviewed in chapter two. Many source functions are of a discontinuous nature and the consequent need for care in the mathematical treatment is emphasized. Superposition theorems which enable a solution to be obtained for any source function are also given in this chapter.

Chapter three is somewhat out of keeping with the remainder of the book as it deals with the electrical analogues commonly used to represent thermal and mechanical systems. It does, however, enable the analytical methods given in the book to be applied to such systems, for many examples of the analogues are evaluated. The simplicity of Heaviside's operational method has great appeal to the practising engineer, and this method is described in chapter four. Chapter five introduces the Laplace transform concept and extensive tables of transform pairs are included. These tables provide sufficient information to cover the majority of practical problems. Finally, there is a chapter covering the frequency spectrum concept, so useful for the analysis of control and other engineering systems.

The book is suitable for undergraduates and as a reference book for those engineers not primarily concerned with transient phenomena.—K.W.W.

Ibbetson's Electric Wiring. Revised by C. R. Urwin, W. F. Parker and F. G. Thompson. Pp. 296; figs. 119. E. & F. N. Spon, Ltd., 22, Henrietta Street, London, W.C.2. Price 11s 6d.

This is a book which would be useful to young students studying for an examination in the specialized subject of electric wiring, but it would be of less value to the installation designer and still less to the practical wireman. It includes a considerable amount of general electrical theory much of which is already in the standard text books used by students of electrical engineering, and which is of little value to the practical wireman. The book appears to have been written with a known examination syllabus in mind. There is perhaps more mathematics than the subject warrants, and the table of the complete Greek alphabet at the beginning of the book may scare off some readers. Their confidence may be restored however by finding a number of simple and traditional illustrations such as the thumb and forefinger rule for direction of current, the cross section of a telephone mouth piece and the diagram of a simple bell which they will recognize as old friends.

The book contains chapters on general principles, on resistance and two chapters on Ohm's law, one of which, curiously enough, contains a dissertation on electricity tariffs. These are followed by a chapter on insulating materials and cables and here again the paragraphs on resistivity, permittivity and dielectric loss may be considered a little out of place in a text book on wiring. There are useful chapters on distribution systems and systems of wiring and on testing. There are chapters on instruments, communication systems, illumination, primary and secondary cells, small generating plant and motors. The subject of earthing is dealt with to some extent in the chapter on testing but in view of the increasing importance of this matter it should perhaps have had a chapter to itself and should have been dealt with at greater length even if this meant leaving out some of the chapters which are not entirely relevant to the subject of "electric wiring" such as those dealing with primary and secondary batteries or communications. But one has always to remember the examination syllabus.—F.J.

Meter Engineering. By J. L. Ferns. Sixth edition. Pp. 353; figs. 199. Sir Isaac Pitman & Sons, Ltd., Parker Street, Kingsway, London, W.C.2. Price 27s.

This well-known and what may now be regarded as standard work, is before us again in its sixth edition; established engineers concerned with measurement will know it already, but they may be glad to have this new edition to hand. It should have a real appeal for the younger engineer, even though meter engineering may not be his final bent, for it is almost certain that he will spend some part of his training period in a modern meter department.

The section on "Measurement of Electrical Energy," running to 90 pages, is good; it combines practical application with a sound and rather modern mathematical approach. The section on the Electricity Supply (Meters) Act, 1936, is concise but the book does contain references to "undertakers" and tends to imply that the Meter Act and nationalization have not yet made their full impact on the meter industry. If this should confuse the reader, it must be remembered that the appeal of this work goes well beyond our own shores.

The practical side deals with the treatment of jewels, pivots, magnets and not least, mercury, in fact a good insight into the daily routine of a modern meter department. The illustrations are not quite of the best for examination of detail, and in our opinion, more recent examples of two element meters and a Trivector could have been used with advantage.

Of the appendices, integration, vectors and trigonometrical identities are handy inclusions. The slide rule section is rather brief and for this reason is not quite as attractive as "Notes on Recent Development" which might have been expanded. "British Legal Standards" is well set out and usable. The book can be recommended to meter men at all levels and ages.—H.E.L.

Atomic Energy and its Applications. By J. M. A. Lenihan. Pp. 265; figs. 73. Sir Isaac Pitman & Sons, Ltd. Price 22s 6d.

Between now and the end of the century the world's major power source will undoubtedly be nuclear. Few engineers have much knowledge of nuclear physics, so the value of this book is assured since it gives a simple account of the physical foundations of nuclear science, and a concise description of its applications. It also indicates possible future progress in the exploitation of atomic energy.

The book, which can be understood by anyone with a modest scientific knowledge, starts by summarizing current ideas on atomic structure, X-rays and radioactivity. Nuclear stability and binding energy are dealt with next to provide a foundation for subsequent inquiry into the fission process to which a whole chapter is devoted. Descriptions are given on the methods used for detecting nuclear radiations by ionization chambers, Geiger-Müller counters and other devices.

High-energy physics is also well covered, one chapter being devoted to particle accelerators and another to consideration of the nuclear reactions initiated by energetic particles or radiations. Three chapters are devoted to nuclear reactors used for the release of energy and the production of radioactive materials. An account of the production of artificial radioactive materials and a summary of the precautions necessary in their use is followed by chapters dealing with their practical applications in medicine, science and industry.—R.P.

ELECTRICITY IN COAL MINING

5.—Mains Lighting Underground

By D. A. STRACHAN, F.I.E.S. (Lighting Engineer, National Coal Board, London)

THOSE employed underground must necessarily depend entirely upon artificial lighting, both to reach their place of work and to carry out their various tasks with safety and efficiency. It is therefore apparent that everything possible should be done to improve the standard of underground lighting. Considerable advances have been made in the mine lighting field during recent years and this article reviews the position with regard to mains lighting underground.

The conditions under which electric lighting may be used underground in a "safety lamp" mine are clearly defined in the 1947 Lighting Regulations.[1] These regulations permit the voltage in the system to be a maximum of 250 with the proviso that in a polyphase system the neutral point shall be earthed, and in a system which is not polyphase, the mid-voltage point must be earthed. Electric lighting may be permitted to within 50 yd of the nearest coal face where there is intake air or to within 300 yd of the nearest face on return-air roadways. Where electricity is already provided on the face in any ventilated district, mains lighting may be permitted to within 10 yd of the coal face.

In general, the lighting problems associated with underground roadways are similar to those for any long, narrow tunnel except that the application of the equipment is made more difficult by the particular physical conditions. In considering whether the full length, or only part, of the roadway should be illuminated, it is possible to make out a reasonable case on either account. One alternative would require the provision of adequate lighting in the vicinity of specific working areas only, such as the pit bottom and inbye at transfer and loading points, whilst the other possibility relates to the provision of continuous lighting from the pit bottom to the face itself.

On the assumption that in the future transport between the shaft and face may be largely by locomotive haulage, there would appear to be no sound case for continuous roadway lighting except in special circumstances. However, this form of transport presupposes that the track will be maintained in good order and on this account, lighting over the full length of the roadway may be justified. On the other hand, it may be illogical to provide a well lighted pit bottom and coal face, leaving the greater part of the intermediate sections in darkness. However, the economics of an installation must not be overlooked and each particular scheme should be treated on its own merits.

Except in specific working areas where higher levels of illumination are demanded (say 4-6 lm/sq ft for transfer and loading points), the minimum standard of lighting (say 0·2-0·4 lm/sq ft) over the remainder of the illuminated sections inbye, should be sufficient to ensure that objects are readily visible and that the course of the roadway ahead is made clear. In any roadway lighting system, reasonable uniformity is desirable and dark areas between adjacent lighting fittings should be avoided if possible; furthermore, there should be freedom from "glare" if good visibility is to result.

In this connection, it is usual to classify glare under two broad headings: disability glare which is normally associated with excessive light entering the eye from the light source itself; and discomfort glare which usually results from excessive contrast between the light source and its background. These suggest that the luminance of those parts of lighting fittings which are visible within normal angles of view should be as low as possible and also that the reflection factor of the background, i.e. the sides and roof of the roadway, should be kept as high as possible (section 1 of the 1947 lighting regulations referred to earlier calls for the effective whitening of specified places).

Generally the lighting of pit bottoms and underground roadways has developed along fairly conventional lines, within the limits of the available equipment. The majority of installations make use of 60 or 100 W tungsten filament lamps in well-glass and bulkhead type fittings, spaced

40 W 2ft flameproof fluorescent fittings in a mine roadway

Coal face experimental fluorescent lighting installation employing 30 W lamps

40 W circular fluorescent fittings, mounted on the conveyor structure at the coal face

Tungsten lighting at the coal face using 60 W lamps with opal "Perspex" covers

up to 40ft apart, depending upon the height of the roadway and the illumination standard required. In addition, there are now several systems which employ tubular fluorescent lamps of the 20 W 2ft to 80 W 5ft sizes in flameproof or dustproof fittings.

It is unfortunately true to say that in the past there has been a somewhat limited range of suitable equipment for this important application. In many cases, resort has had to be made to the use of fittings which have been designed for a wide variety of applications and whilst several very desirable mechanical features may have been incorporated they are, and have been, largely inadequate when considering the lighting result. One such example is the popular well-glass pendant fitting in which there may be no provision for light control or for limiting the luminance of the source. However, certain design and experimental work which has been undertaken during recent years is now showing results and the future should see the development of further lighting equipment which has been designed specifically to meet the requirements of underground roadway lighting.

The history of general lighting at the coal face[2] is long and in many respects disappointing. Mains lighting by tungsten filament lamps at various voltages, with both simple and complicated circuit arrangements has been tried and although the duration of the trial period was in many cases insufficient, successive experimental installations failed for a variety of reasons although much useful experience was gained. Also, the conditions imposed by the Coal Mines Act of 1911 limited such installations to naked light mines only, and it was not until 1934 that the introduction of mains lighting on the face in safety lamp mines was permitted.

The experimental installations in service prior to 1939 had varying degrees of success, but the ultimate outcome was somewhat disappointing because of the unsuitability of some equipment, the high luminance of the source, or the high cost of maintenance. Nevertheless, credit is due to those who persevered with the early attempts to introduce face lighting, particularly in view of the problems of equipment and application involved.

Practical Difficulties

The problems associated with the successful application of general lighting at the coal face[3] are many and varied, whereas those associated with roadway lighting are rather less acute. It may be appropriate therefore to list the difficulties which have to be faced when considering a system of general lighting on a long wall face. First among these is the advance of the coal face during a shift; the lighting fittings may be 6ft distant from the face when a shift begins, and 12ft from the face at the end of the shift. (This will not apply where the lighting equipment is permanently mounted to any conveyor structure which is advanced as the coal is won.) Other difficulties are the generally restricted height, the moving forward of the equipment as the face advances, the possibility of damage to the equipment due to shotfiring, the low reflection factor of the coal which absorbs between 88 per cent and 97 per cent of the incident light, the avoidance of "glare," the achievement of a reasonably uniform level of illumination along the face, consistent with the relatively low mounting height and the distance of the fittings from the face, the provision of adequate illumination of the waste, as well as of the face, and the suspension of the fitting at the face.

As regards the application of mains lighting at the coal face in "safety lamp" mines, the regulations require that Section 10 of the Coal Mines (Lighting) General Regulations of 1947 should be supplemented by special regulations relating to lighting otherwise than by means of locked safety lamps, which among other things, require that the pressure be limited to a maximum of 125 V.

The illumination requirements at the coal face are particularly exacting. The lighting standards achieved underground must not be compared on the same basis as those accepted for surface installations; conditions are so different

and the problem so complex that the illumination values recommended for underground positions cannot be judged by ordinary standards. For this reason, it may be readily appreciated why the figure of 0·4 lm/sq ft is the accepted standard for coal face lighting installations. This figure, although low by normal standards, is based on fundamental principles and is related to the disease known as miners' nystagmus.[4] This disease, which shows itself as an oscillation of the eyes, is almost certainly caused by the fact that the fovea, or central point of vision is inoperative at very low illumination levels and under such conditions, "seeing" can only occur through the periphery of the retina.

In order to overcome the mechanism of oscillation the illumination must be sufficient to permit of central conal vision, hence the selection of 0·4 lm/sq ft as the standard of illumination required under the particular conditions for the eyes to work normally. Following the failure of the earlier attempts to introduce general lighting at the face, the introduction of the mains voltage tubular fluorescent lamp in small sizes (18 and 24 inches) seemed to provide a new approach to the problem and brief reference to the experimental installations may be of interest although these are more fully reported upon elsewhere.[5] In the experiments referred to, two types of "approved" lighting fittings were in service, one producing a mainly directional light distribution and the other providing a virtually "all-round" light, limited only by the channel housing the auxiliary gear. The first installations made use of 15 W and 20 W fluorescent lamps, but these were later superseded by the 30 W and 40 W sizes.

Generally the lighting fittings were mounted as high as possible, supported in the line of roof supports immediately behind the face conveyor and the spacing between adjacent lighting units varied with the installation over a range of 10 to 15ft. Although it was necessary to make some alterations to suit particular local conditions, a more or less standard arrangement was adopted which provided for the lighting fittings being mounted horizontally, parallel to the face.

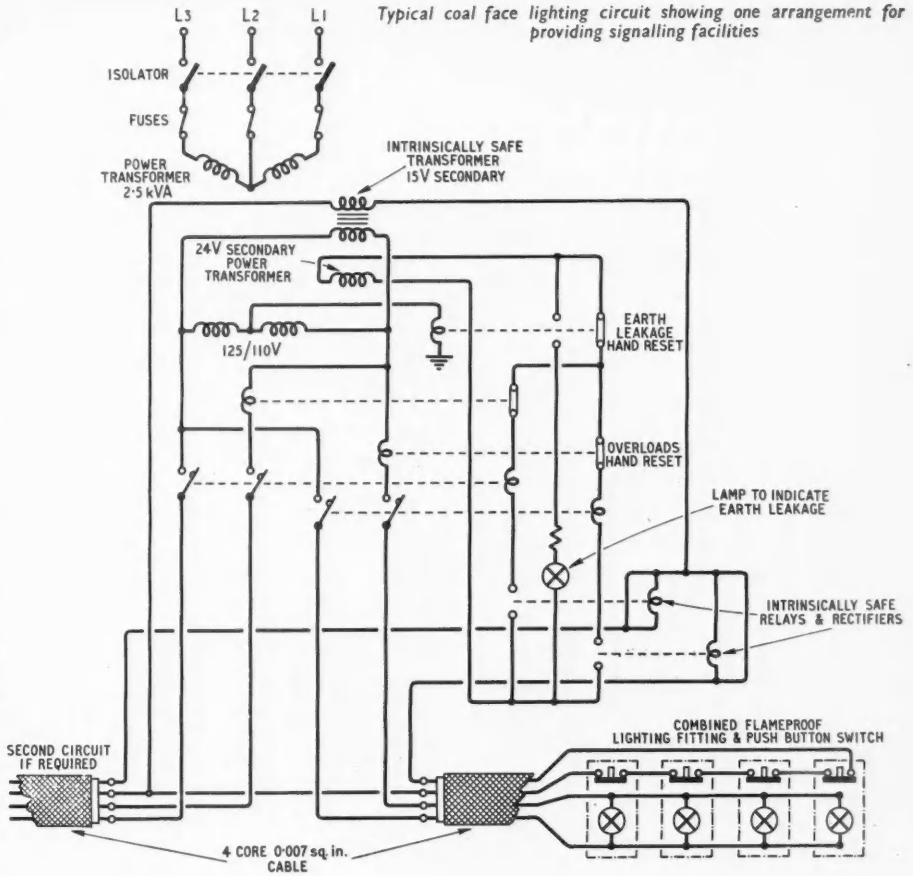
Illumination surveys were carried out periodically at each face where the experimental fluorescent lighting was in service. To quote the figures achieved at one colliery where 40 W 2ft lamps were employed, the average value opposite the lamps was 0·68 lm/sq ft and mid-way between lamps 0·38 lm/sq ft, the distance of the lamps to the face being approximately 9ft. It will be noted that under the worst conditions, that is mid-way between the adjacent lamps, the level of illumination falls just short of the 0·4 lm/sq ft mentioned earlier. However, as the standard of illumination at the face is a function of the lamp watts, the spacing between fittings and the distance of the lamps to the face, this can be varied if warranted and justified economically.

The experimental period of about five years was concluded in late 1953 and the results show that mains-lighting at the face is practicable under certain conditions and that the equipment can be installed and maintained successfully.

Since the date of the first experiments, an additional fluorescent fitting has been developed, which is circular in form.[6] The fitting in question accommodates a 40 W 10in diameter circular fluorescent lamp which is seated in a circular anodized aluminium reflector; a domed front cover of toughened glass protects the lamp and the auxiliary gear is contained within the fitting. Although the original experiments were confined to fluorescent lighting, the possibility of successfully employing metal filament lamps for coal face lighting has always been pursued and it may be of interest to report that a 60 W flameproof fitting has since been developed and that a successful trial installation has been undertaken at a colliery in the Midlands.

The fitting in question utilizes a dished cover of high transmission opal "Perspex" to reduce the luminance of the source to about half that of the tubular fluorescent lamp. Also, this particular fitting incorporates a plug and socket arrangement which does away with the necessity for providing separate cable couplers in the run of cable between adjacent fittings. One other tungsten lamp fitting

Typical coal face lighting circuit showing one arrangement for providing signalling facilities



which incorporates a serrated well-glass has been developed and there are a number of installations in service. An interesting feature of this particular fitting, which also applies to the circular fluorescent unit and the 60 W fitting referred to earlier, is that the respective lighting systems can provide signalling facilities by the incorporation of push buttons within the lighting fittings, and such an arrangement may have merit on mechanized faces where a simple code of flashing lights could be instituted to give a number of basic signals.

The practice of adapting the coal face lighting system to provide visual signalling on mechanized faces has been developed particularly on the Continent and it is only more recently that consideration has been given to this feature in British mines. In one system, shown in the diagram, where the secondary output is single-phase, signalling is achieved by interrupting the pilot circuit which is connected through the push buttons incorporated in the lighting fitting.

An alternative arrangement for the 3-phase system makes use of a patent circuit which includes a half-wave rectifier between the remote end of the pilot and earth cores, the action of depressing the push button causing the controlling contactor in the gate-end transformer to open and thereby extinguish the light; release of the push button then recloses the contactor.

With regard to the circular fluorescent units it is possible for these to be adapted to provide signalling facilities if required since an " instant-start " system of lamp operation is employed, thereby dispensing with the conventional starter switches which would limit rapid switching.

It may be appropriate to make some reference to the operating costs associated with the provision of mains lighting at the coal face. The experimental fluorescent lighting installations have shown the overall cost figure to vary between 2d and just under 3d per ton of saleable output. Although the experience of incandescent lighting at the face is limited, it appears that the overall cost per ton figures may be a little less than those quoted for the fluorescent lighting installations but this is subject to confirmation.

The future development of coal face lighting is, for the present, restricted owing to the prohibition of the use of aluminium at the coal face. The wider application of coal face lighting is therefore bound up with the introduction of a range of suitable equipment which is constructed other than in aluminium and it is hoped that the next few months will see developments in this direction.

In conclusion, the author wishes to thank the various manufacturers and N.C.B. Areas who have kindly provided illustrations and photographs.

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In Part 2 of this series (1st April) the terms 8 A, 16 A and 112 A in the last seven lines of the second column (p. 532) should have read 8 mA, 16 mA and 112 mA respectively.

Electronic-Analogue Computing Techniques

THE discussion on the paper presented by Dr. D. M. MacKay before the joint meeting of the Measurements and Radio Sections of the Institution of Electrical Engineers on 5th April (see *Electrical Review*, 8th April, page 588) was opened by Mr. D. J. Mynall (Rugby), who said that function generation had received a small amount of attention only in the paper. While it was true that the photo-electric curve follower had severe frequency limitations, the system put forward in the paper did not exactly replace it. The basic amplifier circuit seemed to have a surprisingly small internal gain before the positive feedback was applied. In his experience it was useful to start with an amplifier having a gain of 100,000 before it was fed back and even then it was useful to put in some positive feedback. It seemed safer, strangely enough, in the engineering sense to start with a very high gain and apply a little positive feedback than to try to whip up the major part of the gain afterwards.

Mr. E. H. Cooke-Yarborough (Atomic Energy Research Establishment, Harwell) said that the biggest snag in these computers was drift. At first he thought Dr. MacKay had overcome this problem, but now he was not so sure that the order of magnitude of drift was any better than in an ordinary slow analogue computer. He was interested in the good performance of the germanium diode switches and wondered whether it was necessary to select diodes to achieve such good results. If his diode switch was so good, could he not have used a similar switch in his amplifiers for d.c. compensation, thereby improving the drift situation ?

Mr. E. G. C. Burt (Royal Aircraft Establishment) referred to the " quarter squares " multiplier and said he was convinced that nothing was gained by the procedure described, since although only two diode networks were used on this circuit, five amplifiers were employed. In an alternative arrangement used at the R.A.E. there were two symmetrical diode characteristics, that was to say, four diodes, but only three amplifiers were required. With regard to non-linear function generators, the system seemed only to be useful when the independent variable x was directly related to time. Non-linear systems involved non-linear functions of the dependent variables. The diode technique could be extended to include such functions.

Mr. K. W. Thwaites (A.S.R.E., Portsdown) observed that the significant part of the paper was Dr. MacKay's success in being able to reset his integrators and other elements of the computer and also to change his coefficients at a very high speed. Might it not be possible to go further and use this technique for actually measuring the output from the computer continuously, using the output to determine which coefficients to feed back into the computer chain ? He was not sure that the positive feedback amplifier described would work with a differentiating circuit because the stability of the phase-margin would be reduced. Again, the high-speed process in the computer might lead to trouble with the hysteresis effect in the condensers.

Mr. C. A. A. Wass (Royal Aircraft Establishment) said his department claimed to have the largest collection of analogue computers in at least Western Europe. They worked in one-to-one time not because the RA.E. was unaware of the attraction of rapidity but because parts of a real system could be included. A whole motor could be put in the machine and subjected to input signals of a more realistic kind than could be produced on the bench.

Engineering in Europe

Abstracts from Foreign Technical Journals

CATHODIC protection of buried metal structures may be carried out in two ways, by forming a galvanic element in which the metal to be protected forms the cathode and another suitable metal buried at some distance from the structure to be protected, the anode with the soil in between acting as electrolyte (sacrificial protection); or by burying an anode metal and providing the current from an extraneous source. For the first method, suitable anode materials are magnesium, aluminium or zinc. Of these, magnesium has the highest dissolution potential and is therefore most appropriate. The technique of cathodic protection is already well developed and can cater for any of the widely varying aspects of structures to be protected, of the medium in which they are buried or submerged (since the method is also used for the protection of submarine structures), and of the temperature and climatic conditions affecting the corrosion processes, etc. Special types of protective anodes to suit various purposes have been developed and are commercially available, and the method answers well also in cases where internal protection is required, viz., boiler and container-type structures, the corrosion of which is threatened from their liquid contents. Many variants of protective systems and their main elements are described and discussed in the article.—"Cathodic Protection: Use of Magnesium Anodes," B. J. C. Raclot, *Bull. Soc. Franc. Elect.*, 7th Series, Vol. 5, No. 49, pp. 9-18, January, 1955, in French.

Forced Generator Excitation

This report concerns a model investigation, in parallel with theoretical investigations, of the stability conditions of a certain variant of the 1,000 km transmission line, Kuibyshev-Moscow, viz., the variant using series capacitors for compensating the line inductance (42 per cent) and shunting reactors. The parameters of the hydrogenerators of the Kuibyshev hydro-electric station and of the regulating system of the hydraulic turbines could be represented in a good approximation by the model. The forced excitation circuit was modelled by a circuit containing main and booster exciter with relay control, operating with a delay of 0·04-0·08 sec if the modelled time constant was 0·36-0·08 sec. Another alternative, time constant zero, enabled forcing by electronic convertor to be modelled. It was, however, possible to increase the time constants to 8-12 sec. Also, the effect of the damper cages of the hydroalternators could be studied, since every test was carried out with and without cage. The tests showed that the increase of the e.m.f. and therefore the improvement of the dynamic stability, depend on the steepness of the no-load characteristic and that the effect of the forced excitation is much reduced if the slope of the saturated part of the characteristic is too flat. High ceilings of the excitation may be obtained at considerable rates of rise of the voltage by forcing by means of electronic convertors. Excitation regulators responding to derivatives of the controlled quantities may achieve a forcing effect and rapid variation of the voltage, but will not send sufficiently strong currents through the field windings of the generator. The damper winding has no appreciable effect on the limit of the dynamic stability in the case of a long transmission line.—"The Problem of the Effectiveness of Forcing Generator Excitation," V. A. Venikov, A. V. Ivanov-Smolenskii and V. I. Gorushkin, *Elektrichestvo*, No. 1, pp. 12-19, January, 1955, in Russian.

Fuse Performance

A theoretical investigation shows clearly that the work during the breaking process is determined in the main by the voltage curve during this process. The severest conditions are represented generally by an arc inception 10-30 deg before a voltage peak. This most unfavourable case of rupturing duty should be determined individually for every overcurrent factor of a given fuse type and should also be considered in development work and in stipulating regulations for fuse tests. In this way a small number of tests will provide the whole information required on the effective breaking capacity of any fuse type, which is possible only if it can be made reasonably certain that the testing conditions are the most unfavourable which could actually arise. The influence of the power factor on the actual fuse performance is, by comparison, subordinate. However, where energy liberated during the breaking process is concerned, this increases with decreasing p.f. It is therefore justified to establish limiting values of the p.f. of fuse-protected installations; for l.v. installations this should be $\cos\phi = 0{\cdot}3$; for h.v. installations $\cos\phi = 0{\cdot}15$. The investigation is based on realistic assumptions on the distribution of the energy to be dissipated, on contributions from generator, magnetic energy stored and heat loss energy, and therefore yields reliable fuse-performance criteria.—"Influence of Breaking Instant and Power Factor on the Performance of Fuses in Clearing Short Circuits," F. Meier, *A.S.E. Bull.*, Vol. 46, No. 3, pp. 101-108, 5th February, 1955, in German.

H.V. System Earthing

Solidly earthed transmission systems require far more elaborate earthing installations than systems with a neutral earthed through current-limiting or arc-quenching coils, because every short circuit to earth becomes a single-phase fault in them and sets up correspondingly large fault currents. The problem of correctly designed earthing systems is a fairly intricate one and must be based on the correct evaluation of the dissipation resistance of the various types of earth electrodes used, the nature and condition of the soils into which they are sunk (these are affected by considerable seasonal and other variations), on the effect of interconnecting the electrodes to form earthing systems, and on the depth at which they are buried, etc. The effect of earth wires, if any, must also be taken into account. On the other side, there are potential dangers to human life and health to be considered and it is therefore necessary to check contact and step voltages in and around stations, pylons, and other parts of the plant by calculation and measurement and last, but not least, the interference effects on neighbouring communication lines. The methods suggested in the article are all well proven and selected

Readers who require accurate full translations of any of the articles abstracted in this section can be put into touch with the translators who will supply them at current rates.—Editors, *Electrical Review*.

from the viewpoint of expediency and safety, i.e., requiring a minimum of calculation and instrumentation (in the case of measurements) and yet furnishing results accurate enough for the purpose in mind.—" Problems of the Earthing of V.H.V. Stations, Particularly Considering the Practice of Measurements," W. Erbacher, *Osterr. Z. Elekt-Wirtsch. (OZE)*, Vol. 8, No. 1, pp. 1-12, January, 1955, in German.

Core Re-magnetization

Ferromagnetic materials with rectangular hysteresis loops have lately gained in interest and are used on a fairly large scale in relays, automatic and telecontrol equipment and in electronic calculating machines. Such cores are often re-magnetized by current pulses and the re-magnetization time then depends, as is shown theoretically and experimentally, on three factors, viz., the influence of the eddy currents in the core, the de-magnetizing effect of the current in the winding in the load circuit and the time constant of the magnetizing circuit. The time taken for re-magnetization is inversely proportional to the steady-state value of the re-magnetizing field minus the coercive force, and its component due to eddy currents is proportional to the square of the thickness of the strip or ribbon type material forming the wound core, and to its conductivity, but is independent of the core dimensions. If there is no delay of the re-magnetization by eddy currents, the flux increases linearly with the time. Any disturbance of this direct proportionality must be due to eddy currents. It is therefore incorrect to consider the influence of the eddy currents by the introduction of a short-circuited turn in the winding as suggested by other authors.—" Current-Pulse Re-magnetization of Cores with Rectangular Hysteresis Loops," M. A. Rozenblat, *Elektrichestvo No. 1*, pp. 24-28, January, 1955, in Russian.

Grouped H.V. Conductors

The use of grouped conductors enables very high voltage transmission lines to be operated without longitudinal capacitive compensation, provided the relative spacing of the conductors in a group compared with the spacing between groups is correctly chosen. Particularly, referring to a 400 kV line with conductors of 36 mm diameter, 500-600 MW may be transmitted through a single circuit with twin groups of conductors over 500-600 km (assuming critical corona voltage as 525 kV); with triple-conductor groups in single-plane arrangement, the same power over 700-800 km, and with quadruple groups, up to 1,500 km. The distributed reactances corresponding to these cases are $\alpha \geqslant$ 0·32; 0·22 and 0·17 ohm/km, respectively. In all cases the phase difference of the voltage vectors at the line ends will not exceed 35 deg. These theoretical results are achievable in practice, but the actual construction of the lines for the transmission of powers representing up to 2·25 times the natural transmitting power of an ordinary 400 kV line will still require some preliminary development work, particularly on the most suitable design of supports, insulator strings, fittings such as spacers for the conductors of a group, releasing clamps, etc. Also, special types of conductors of 36-37 mm diameter will have to be developed.—" Electrical Characteristics of a 400 kV Transmission Line with Grouped Conductors," N. F. Rakushev, *Elektrichestvo No. 1*, pp. 8-12, January, 1955, in Russian.

Testing Insulating Varnish

The importance of the optimum characteristics of insulating varnishes used on machine windings is not sufficiently appreciated by the industry nor is the knowledge of the conditions to be satisfied by varnishes widespread. Theoretical and experimental investigations have long succeeded in establishing criteria of the service life of insulants in terms of their resistance to heat and their thermal conductivity and this, together with electrical and mechanical characteristics of the hardened varnish coating or impregnation, determine ultimately the quality and durability of a winding insulation. However, the distinction between coating and impregnating varnishes is important and leads to different conditions to be satisfied by them. The impregnating varnishes form part of the basic insulation and the coating varnishes have mainly to protect the basic insulation against any obnoxious extraneous influence. If all the essential requirements for both kinds of varnish are clearly understood, all the characteristics of the varnishes which really matter can be tested by simple methods requiring neither a special laboratory nor elaborate equipment. The main pieces of equipment needed are a heating cupboard with thermostatic control up to 200 deg C, analytical scales and a voltage transformer with tap changer up to 20 kV. The smaller equipment will be either available in the workshops or may be produced there without difficulty. The author describes the whole series of necessary tests in detail and illustrates the methods by a good selection of typical test results.—" Testing of Insulating Varnishes for Windings in Electric Machine Production," E. Breunlich, *E.u.M.*, Vol. 71, No. 19, pp. 453-461, 1st December, 1954, in German.

Accelerated Ageing of F.H.P. Motors

DETAILS of a laboratory ageing test adopted for their f.h.p. motors have been received from Crompton Parkinson, Ltd. In this test motors are subjected, at a greatly accelerated rate, to the four main influences responsible for breakdowns in service—electrical stress, overheating, vibration and dampness. It not only serves to indicate the degree of reliability that users can place in their motors, but provides invaluable information for the designers on how the materials used in construction react collectively to severe operating conditions. To simulate severe operating conditions, a motor is subjected to continuous reversing cycles, allowing it to reach maximum speed in one direction and then reversing it to full speed in the opposite direction. This treatment in itself subjects the motor to greatly accelerated ageing effects, since the continuous reversing cycles bring about high temperature and cause electric impulses at the moments of reversals together with intense vibration and mechanical forces on the windings. The fourth deteriorating factor, dampness, is obtained by cooling the heated motor after each day's testing in an atmosphere of 100 per cent humidity.

When the first motor was subjected to the test, it ran for a million reversals without failure; a second standard production motor was tested, but this too was still in good running order after a million reversals. So that it could be tested to destruction, the motor's air ducts were blocked, but after a further million reversals, the insulation resistance was still in the region of 20 megohms. With the object of increasing the shell temperature again, the shell was partially lagged and the motor subjected to yet another million reversals. Its shell temperature during this series of reversals was forced up to 134 deg C, but even this temperature, which is 44 deg C above that allowed in B.S. 170/1939 for full-load conditions, did not seem sufficient for breakdown although the insulation resistance had at last been reduced to 10 megohms. Finally, the motor was fully lagged so that its shell temperature reached 165 deg C, but still the motor resisted a further 180,000 reversals before one of its coils eventually burnt out.

In all, this standard f.h.p. motor endured the excessive electrical stresses, overheating and vibration imposed by well over three million reversals before it was possible to break it down, and this was no exception as has been proved in subsequent tests on other standard machines.

VIEWS on the NEWS

By REFLECTOR

AT a meeting of various public bodies recently, Lord Waverley discussed the increasingly serious pollution of the River Thames from various causes. According to the *Manchester Guardian*, which notes that the Press was not invited to the conference, Lord Waverley mentioned among numerous causes that contribute to pollution the prodding of Government Departments to institute measures for removing smoke and sulphurous acids from flue gases and the consequent tendency to clean the air at the expense of the water. This accords with the results of investigations into the subject, as previously reported in the *Electrical Review*, that no gas-washing plants other than those at Battersea and Bankside power stations could discharge their effluents into the river without reducing its alkalinity below a safe figure.

* * *

In references to railway traction developments the use of diesel locomotives is often mentioned as an alternative to "electrification." This is likely to be misleading, as usually diesel-electric locomotives are meant for routes over which restarting of a train may be necessary and especially for such intermittent work as shunting. Diesels alone do not exercise the high starting torque of steam locomotives or of series-wound d.c. motors, while the fine speed-torque characteristics provided by the electric generator and motors are essential for almost all duties. The term "diesel-electric," besides being free from ambiguity, gives proper credit to the manufacturers of the electrical machines and their control equipment.

* * *

While two years is certainly not too short a period between international conferences on power transmission, the programme of C.I.G.R.E. tends to become inconveniently overloaded. The practice at recent meetings of having concurrent discussions of two groups of subjects has the disadvantage that many members are likely to be interested in both. There is much to commend in the decision of the Administrative Council to divide the papers into two categories as set out in "Electra" (the C.I.G.R.E. "news letter") for March, so that those branches in which technical advances are less rapid will in future be discussed at four-yearly intervals. Presumably enough flexibility will be allowed to provide for the inclusion of unforeseen developments of major importance that may occur in deferred subjects.

* * *

The North of Scotland Hydro-Electric Board sets a good example in public relations. It has been remarkably successful in "selling" hydro-electric development, even to the amenity and angling societies and in spite of the large-scale operations which it is carrying out has met with very little opposition. I learn, from the *Scotsman*, that it is also at present collaborating with archæologists by giving permission for excavation work to be carried out at a Mesolithic site brought to light in the course of tunnelling at the Board's Kimelfort scheme in Argyllshire. Inside a small cave 15-20ft below the surface have been found worked flint and pieces of quartz foreign to the basalt rock on the hill. Mr. George Banks, the Board's industrious information officer, speaking of this to members of the Society of Antiquaries recently, said that the Board's schemes presented great opportunity for discoveries of archæological interest and he was happy to say that both engineers and contractors take an interest in this side-line of hydro-electric development.

* * *

In a letter to the *Evening News* (Glasgow) a consumer relates an experience which I hope, in the interests of the cooker development campaign, is unusual. He says:—

> "As I live in Glasgow, I went to a nearby electricity showroom that was full of sparkling cookers, including the very model my wife wanted. But we could not have it. By some twist of electrical boundaries, we are in Lanarkshire Sub-Area, although we live in Glasgow, S.4. The nearest Lanarkshire showroom with a decent selection of cookers we could find was at Hamilton—15 miles away. So off we went by bus to Hamilton and chose our cooker without any difficulty. The bill came a few days later and was promptly paid. That was in January."

The cooker was ordered for delivery by the end of February but up to 12th April had not arrived although he had written three times. I hope that his perseverance will soon be rewarded.

* * *

In its "Miscellany" section the *Eastern Electricity Magazine* mentions the showing of the official colour film of the Uganda hydro-electric scheme in the canteen at Squires Lane, Finchley (of which borough Sir Charles Westlake, chairman of the Uganda Electricity Board, was formerly electrical engineer). Some historical background hitherto unrecorded is suggested by the title of the note "Owen Fails Hydro-Electric Scheme."

* * *

In the early days of the electrical industry meters were not the accurate instruments that they are to-day, but apparently in this they were not alone, for gas meters were known to "swear to the consumption of thousands of feet of gas in a vacant house." Thus a report in the *New York Times*, reproduced in the *Electrical Review* of 25th April, 1885, adroitly turns the failings of a certain electricity meter to good account by saying:—

> "Persons using electric light cannot be too careful to remove their gas meters from the cellar before introducing the electric meter. The probability is that the electric meter is honest when left to itself, but that it is weak and easily led away by bad company."

PERSONAL AND SOCIAL

News of Men and Women of the Industry

Mr. F. J. Erroll, A.M.I.E.E., M.P., has resigned from the boards of Richard Johnson & Nephew, Ltd., and its subsidiary, Johnsons (Mill Street), Ltd., upon taking up the appointment of Parliamentary Secretary to the Ministry of Supply.

Mr. T. Duerden, B.Sc.Tech., M.I.E.E., A.M.I.Mech.E., who has been engineer of the York Sub-Area of the North Eastern Electricity Board since 1948, has been appointed manager of the Sub-Area. He succeeds **Mr. W. A. Crocker,** who has become manager of the Tees Sub-Area.

Mr. T. Duerden

Mr. Duerden was born at Nelson, Lancs, in 1903; he was educated at the Manchester College of Technology and was trained in the Nelson Electricity Department and at the Crompton Parkinson works, Leeds. He was sales engineer with Crompton Parkinson from 1925 to 1928 and then became assistant mains engineer at Nelson. He went to Blackburn Corporation as mains engineer in 1932 and became chief technical assistant there in 1938. In 1945 he went to York Corporation as deputy chief engineer. While he was at Blackburn Mr. Duerden was responsible for the electrical design of the Whitebirk power station, the first stage of which was opened in 1944.

Mr. C. F. Bolton, M.B.E., A.M.I.E.E., who retired recently from the Central Electricity Authority after having been transmission engineer for the South Eastern Division (and previously for South-East England with the Central Electricity Board), has become consulting engineer to the English Salvi Co., Ltd.

Mr. E. G. Spilling, A.M.I.E.E., deputy station superintendent at Coventry in the East Midlands Division, C.E.A., since 1948, has been appointed deputy station superintendent at Westwood power station of the North West, Merseyside & North Wales Division. Mr. Spilling commenced work as an apprentice electrical fitter with Portsmouth Corporation Electricity Department in 1932 and after five years became a student engineer. In 1939 he was appointed assistant shift charge engineer at Portsmouth and in 1945 transferred to Portishead as boiler house shift charge engineer. The following year he was promoted to assistant shift charge engineer and in 1948 left Portishead for Coventry.

Mr. A. McKay, who was until recently a supervisor in the Hoover sales-service organization at Dundee, has been appointed manager of the Bradford district of Hoover, Ltd.

Mr. T. C. Paton has retired from the position of manager of the Glasgow office of Brookhirst Switchgear, Ltd., but will continue to represent another member of the Metal Industries Group, Cantie Switches, Ltd., in Scotland. **Mr. K. B. Allan** has been appointed Glasgow office manager for Brookhirst Switchgear, Ltd.

Viscount Weir of Eastwood, G.C.B., has intimated his intention to retire from office as director and chairman of G. & J. Weir Ltd., with effect from the date of the forthcoming annual general meeting. The board considers that Lord Weir's long association with the company, extending over 57 years, should be recognized, and they propose asking stockholders to approve his appointment as the first honorary president of the Weir group of companies. **Mr. J. Spittal,** director, finance and accountancy, and **Mr. A. H. Laidlaw,** sales and contracts director, have also intimated their intention to retire at the same time. On the retirement of Lord Weir, the directors propose to appoint the **Hon. J. K. Weir,** C.B.E., the present managing director, to be chairman, and the position of managing director will be held jointly by the **Hon. J. K. Weir** and **Mr. J. R. Lang.**

The board also announces the appointment of the following executive directors, whose duties will be to manage the affairs of the Cathcart organization:—**Hon. J. K. Weir** (chairman), **Mr. J. R. Lang, Mr. H. Hillier** (who are members of the parent board), and **Mr. J. Davidson, Mr. J. W. Atwell, Mr. I. G. Craig, Mr. J. J. B. Young,** and **Mr. D. C. Hagen.**

Mr. J. R. Hanchett, A.M.I.E.E., M.I.R.T.E., has been appointed rolling stock engineer of Huddersfield Passenger Transport Department. Mr. Hanchett was an electrical apprentice with Liverpool Corporation Passenger Transport Department in 1940 and in 1944 he became a laboratory assistant with W. T. Glover & Co., Ltd., in connection with the manufacture of the H.A.I.S. cable (PLUTO pipeline). In 1945 he was appointed experimental assistant at the Admiralty Engineering Laboratory, West Drayton, Middlesex for development work on prototype naval equipment. Three years later he became assistant electrical engineer, Birmingham City Transport, and in 1952 took up his present position of assistant rolling stock engineer, Bradford City Transport.

Mr. F. L. Haxell, assistant general secretary, Electrical Trades Union, has been elected general secretary. He is a member of the national executive of the Communist Party and he succeeds the late Mr. W. C. Stevens, who was also a Communist.

Commander C. F. Nock, D.S.O., O.B.E., informs us that he recently reverted to the retired list of the Royal Navy. Before he resumed naval service in 1951 Commander Nock was successively sales manager of the Hopkinson Electric Co. and sales director of the Tuscan Engineering Co.

Mr. P. A. Morton, sales director of Tullis Russell & Co., Ltd., has retired from that position, but will remain on the board of the company. To mark the occasion Major D. F. O. Russell, chairman and managing director, entertained the directors and sales managers to dinner at the Station Hotel, Kirkcaldy, when he paid tribute to Mr. Morton's service to the company.

Mr. A. Gemmell

Mr. Morton has been succeeded as sales director by **Mr. A. Gemmell,** who will make his headquarters at Ivorex House, Upper Thames Street, London, E.C.2.

Mr. J. W. Howlett, O.B.E., founder, chairman and managing director of Wellworthy, Ltd., had the Freedom of the Borough of Lymington conferred on him on 29th March.

Mr. R. R. Kennan, A.M.I.Mech.E., general sales manager of Mono Pumps, Ltd., left this country on 18th April to visit the company's agents in Egypt, Cyprus, the Lebanon, Syria, Israel, Iraq, Iran, Turkey and Greece.

At the recent annual general meeting of the **Electrical Wholesalers Federation** Mr. G. Conradi, chairman of the E.W.F.-E.I.B.A. Committee, reported that the 1954 collection of members of the Federation for the Electrical Industries Benevolent Association had been £2,761. The cup presented by Mr. W. Yuille, a former

chairman, for the highest average individual contributions was awarded to the London and Eastern Section. During the meeting, the collection from members present realized £126 10s.

We recently reported that **Mr. R. A. Kirby** was relinquishing the position of works manager of the rubber and plastics cable factories of Enfield Cables, Ltd., to take up an appointment with the company's Australian subsidiary, Enfield Cables (Australia) Pty., Ltd. The accompanying photograph shows Sir Philip Warter, chairman of Enfield Cables, Ltd., bidding farewell to Mr. Kirby.

Sir Philip Warter bids farewell to Mr. R. A. Kirby.

Captain R. C. Petter has resigned his appointment as managing director of Petters, Ltd., Staines, but remains a non-executive member of the board of the company and also of the board of the Brush Group, Ltd., the parent company. Captain Petter accepted the managing directorship of Petters in 1953 on a temporary basis until the Brush Group board was able to make a permanent appointment.

Mr. D. K. Fraser has been appointed a director and general manager of Petters, Ltd. He was formerly works manager of the electrical machines division of the Brush Electrical Engineering Co., Ltd.

Mr. J. Maitland Jones, of Turnbull & Jones, Ltd., Wellington, New Zealand, will be retiring from the company at the end of this month after having completed a period of fifty years' service on the staff. A nephew of one of the original founders of the company, Mr. Maitland Jones came to London in 1919 and from then until 1947 was in charge of the London office. Apart from a brief return during the early 1950's, he has since been at the head office where he latterly took up the appointment of factory superintendent.

Mr. P. L. Jones (director, Swan, Hunter & Wigham Richardson, Ltd.), has been re-elected president of the North East Coast Institution of Engineers & Shipbuilders for 1955-56. The new vice-president is **Mr. J. B. Woodeson** (chairman and managing director, Clarke, Chapman & Co., Ltd.), and the members of the Council include **Mr. A. T. Bowden** (chief research engineer, C. A. Parsons & Co., Ltd.).

Members of the West London Branch of the **Association of Supervising Electrical Engineers** and their wives journeyed to Paris for the Easter recess. Amongst the places visited were the Louvre, Notre Dame Cathedral, Sacre Cœur, and the Palais de Chaillot.

After the final performance of "Suspect" given by the **Pirelli-General Social and Sports Club** drama section at Southampton on 22nd March the leading lady, Miss Norah Bushrod, and the acting producer, Miss Joyce Spreadbury, each received a bouquet from Mr. L. Emanueli, the vice-president of Pirelli S.p.A., Milan. The section's producer, Mr. W. C. Gratton, was taken ill a week earlier and Miss Spreadbury had taken over from him. Mr. Emanueli, who was introduced to the audience and cast by Mr. J. R. Harding, the general manager of Pirelli-General Cable Works, Ltd., was accompanied by Mr. L. Rossari, the manager of the Cable Department, Pirelli, Milan.

OBITUARY

Mr. A. E. Margolis.—The death occurred on 13th April in London of Mr. A. E. Margolis, Dipl.Eng., who had been with Kennedy & Donkin, consulting engineers, since 1941. Mr. Margolis was well known as a specialist on district heating, and before joining Kennedy & Donkin, was responsible for district heating schemes in Hamburg and elsewhere in Germany.

Major G. L. Bradley.—The death has occurred at Hexham (Northumberland) at the age of sixty-seven of Major Guy L. Bradley, who was district representative at Hexham for the North-Eastern Electric Supply Co., Ltd., until his retirement seven years ago. He was with the company for thirty-five years.

Miss Beth Card.—The death occurred on 7th April of Miss Beth Card, branch development secretary of the Electrical Association for Women. Miss Card became a member of the E.A.W. staff in 1933 when there were some 30 branches and the first edition of "The Electrical Handbook for Women" was being prepared. She joined the department dealing with both branch development and publications. At the time of her death there were 151 branches and she had been responsible for the five succeeding editions of the Handbook. In addition, she helped to present the E.A.W. to the public through exhibition work.

WILLS

Mr. W. J. Orange, general manager for India, English Electric Co., Ltd., who died on 2nd August last, left estate in Great Britain valued at £29,416.

Mr. J. Ire'and, manager of the Grantham district of the East Midlands Electricity Board, who died on 17th October last, left £3,021 gross (£2,922 net).

Mr. R. E. Grime, M.Sc.Tech., M.I.E.E., electrical designer, formerly with Mather and Platt, Ltd., who died on 26th October last, left £15,032 gross (£14,859 net).

Mr. R. Falshaw, head of R. Falshaw, Ltd., who died on 9th November last, left £23,954 gross (£23,840 net).

Electrical Engineers' Exhibition

A well attended meeting of representatives of exhibitors at this year's Electrical Engineers' Exhibition was held at Caxton Hall, Westminster, last Monday. Mr. J. Flood, chairman of the Council of Management, presided and he was supported by Mr. E. J. Sutton, chairman of the Organizing Committee, Mr. P. A. Thorogood, general manager of the Exhibition, and Mr. E. A. Bromfield, secretary.

Mr. Flood briefly reviewed the results of this year's display and called for comments. Several suggestions for improvements were made and noted. The arrangements for the 1956 Exhibition (20th to 24th March) were then outlined. Mr. Flood said that Earls Court had been booked from 13th to 26th March, which would give exhibitors more time for the erection and dismantling of their stands; there would be no extra charge to them.

It was considered by the organizers that space should be allocated by ballot and they agreed that preference should be given to exhibitors at the previous shows. The general feeling of those present was in favour of keeping the Exhibition open until 9 p.m. on one day.

Questions were asked about the relationship of the Exhibition to the British Industries Fair. It was replied that there had been no official approach from the Fair authorities. There had been an informal exchange of views with the British Electrical and Allied Manufacturers' Association. One or two speakers expressed the view that limitation of the scope of the Exhibition should be considered. Some wanted the display to be confined to equipment of interest to electrical engineers, but others contended that engineers and other industrial visitors were also interested in the domestic and lighter apparatus. Mr. Thorogood promised that there would be proper discrimination in the acceptance of applications for space.

It was announced that a cheque for 300 guineas had been sent to the Electrical Industries Benevolent Association as a result of collections at the Exhibition.

The proceedings concluded with the showing of a film of this year's Exhibition.

E.I.B.A. Golden Jubilee

Over 600 people were present at a luncheon held last Tuesday, at the Connaught Rooms, London, to celebrate the golden jubilee of the Electrical Industries Benevolent Association. The president, Sir John Dalton (with Lady Dalton) received the guests and took the chair at the luncheon.

Sir John Maud, Permanent Secretary to the Ministry of Fuel and Power, was the chief guest and he proposed the toast of the Association. In the course of his speech, Sir John spoke of the prospects of the electrical industry and said that benevolence was one of the marks which distinguished the really successful. He thought that that day (Budget Day) was an appropriate one for the exercise of benevolence, whether the Chancellor intended to take more money or give relief. Mentioning that in 1929 a sum of £627 was collected at an E.I.B.A. dinner attended by 100 people, Sir John Maud said that making all the necessary adjustments £5 per head from the 600 present would be considered satisfactory.

He considered that the E.I.B.A. had every reason to celebrate its golden jubilee with satisfaction and confidence. It would continue to be very necessary in the years to come. He concluded with a tribute to Sir John Dalton and other workers of the Association.

Replying to the toast, Sir John Dalton mentioned Sir John Maud's versatility and then referred to the beginning of the Association. Then eleven men subscribed £10 each—among them was Mr. A. P. Lundberg, who had sent a message. Among those at the luncheon were Mrs. Eck, widow of Mr. Justus Eck, and Mr. Raymond Berry, son of the late H. H. Berry, and a number of the earlier workers of the Association.

It might be wondered why such a prosperous industry had to have a benevolent fund. The reason was that it was a young industry and its pensions schemes were not introduced until fairly late; about a quarter of these 250,000 non-manual workers in the industry were not covered by pension schemes. Even then no pension scheme covered all the work which the E.I.B.A. undertook. Sir John commended the work of the forty-six local branches all over the country; their work was the foundation of the Association. He made special mention of the fact that the Electrical Wholesalers' Federation undertook to collect subscriptions and donations from its members and their staffs and he also referred to the Golf Tournament which last year raised £3,000. He was glad to announce that a member of an eminent electrical concern had just promised £500 for the fund " out of its losses."

A greater membership was necessary if they were to carry the load; at present only a quarter of those eligible were members.

Sir John thanked all the officials and helpers of the Association, particularly referring to Mr. H. Senior Fothergill, secretary, and his staff. In conclusion, he proposed the health of the two guests, Sir John Maud and Mr. Charles Davies, one of the Association's honorary solicitors.

Newspaper Dispute Inquiry

The findings of the Court of Inquiry into the newspaper dispute were published last week as a White Paper (H.M. Stationery Office, price 6d). While appreciating the feelings of the Amalgamated Engineering Union and the Electrical Trades Union that there were no proper negotiations with their unions the Court says that the precipitate action of the local officials in calling the strike (which was unofficial for the first 12 days) was unjustified. It is also considered " most regrettable " that the A.E.U. and the E.T.U. did not adopt a similar attitude to that of the Typographical Association which had not accepted the final offer of the Newspaper Proprietors' Association but was prepared to submit its claim to arbitration.

In the opinion of the Court the rates of wages of engineers, electricians and electricians' assistants should continue to find their place within the wage structure of the newspaper printing and publishing industry in which they are engaged. Such rates must bear fair comparison with those applying in the general engineering industry and a broad relationship on the basis of skill and importance to those of other sections of craftsmen in the newspaper industry. In the light of the existing wage pattern in the newspaper printing and publishing industry the present claim for an additional 58s 6d a week is described as " unrealistic."

No method of negotiating general wage increases in the industry is likely to be regarded as satisfactory by the maintenance men unless it provides for their being represented at all stages and all other unions recognized by the N.P.A. should be similarly treated. It is suggested that the fourteen unions with whom the N.P.A. customarily concludes agreements should co-operate to establish a central body which should in future negotiate on questions of common concern, including rates of pay, conditions of service and the wage differentials applicable to the various grades of workers.

An appendix to the report sets out the basic rates of engineers and electricians and electricians' assistants in the newspaper industry and gives comparisons with those in other industries. Including the final offer of the N.P.A. of increases up to 12s the day work rate in the printing industry for a 40-hour week is £11 2s.

The Budget

Last Tuesday the Chancellor of the Exchequer (Mr. R. A. Butler) presented his Budget to the House of Commons. He spoke of the rising standard of living; since 1951 real wage rates had risen by 6 per cent and real actual earnings by 9 per cent. There had also been increases in social service payments. But between 1953 and 1954 output per man had risen by about 2½ per cent while the increase in wage rates was over 4 per cent. If that tendency continued prices would be subject to constant upward pressure. During 1954 industrial production rose by 6 per cent, exports were well maintained and the home demand expanded. There had been substantial investments in the coal, steel, gas and electricity industries and in new industrial buildings. However, there had been an adverse movement in the terms of overseas trade, and in the sterling areas balance of payments equilibrium in the first half of 1954 had been followed by a deficit in the second.

Mr. Butler said that there was a limit to tax concessions but he intended to make some to encourage production and enable industry to be more competitive. The standard rate of income tax would be reduced by 6d with a reduction of 3d in each of the lower rates. The personal allowance for a single person would be raised from £120 to £140 and that for a married couple from £210 to £240, while the band of income taxable at the lowest rate would be reduced from £100 to £60. The investment income reliefs limit would be raised from £250 to £300 and the children's allowance from £85 to £100. From the P.A.Y.E. point of view the changes would become effective on the first pay day after 5th July.

General Election

The Prime Minister, Sir Anthony Eden, announced on 15th April that there would be a General Election on 26th May. After the Election the House of Commons will reassemble on 7th June for the election of a Speaker and the swearing in of Members, who will number 630, compared with 625 in the present Parliament.

LETTERS TO THE EDITOR

Letters should bear the writers' names and addresses, not necessarily for publication. Responsibility cannot be accepted for the opinions expressed by correspondents.

Street Lighting in 1885

WITH reference to the letter from Mr. C. D. Falcke in the *Electrical Review* of 11th March, the tantalum lamp for 110 V supply was first marketed in 1905, and manufacture in this country by Siemens Brothers commenced in 1907. The high voltage tantalum lamp was introduced in 1910. The efficiencies of the low and high voltage lamps were approximately 1·7 W and 2·2 W per candle power, respectively. The tantalum lamp was very robust and constituted the first lamp to be made with a drawn wire filament, tantalum metal being extremely ductile. One peculiarity of the tantalum lamp when used on an a.c. supply, however, resulted in the filament undergoing a curious change. Viewed under a microscope the structure of the tantalum wire after the passage of an alternating current, resembled the segmented formation of a bamboo cane. In those early days, of course, most supplies were d.c. anyway and the tantalum lamp was very reliable.

The two-lamp adaptor referred to by Mr. Falcke was marketed in 1905 by Siemens in order to enable two tantalum lamps to be used in series from one lampholder originally installed for a carbon filament lamp. The development of a method for drawing tungsten wire and the extension of a.c. supplies, combined to render the tantalum lamp obsolete.

On the subject of early street lighting mentioned by your correspondent, it is of interest to record that in 1883 electric street lighting was installed in Godalming, Surrey —the first English town to combine public and private lighting by electricity in one commercial undertaking. The current was supplied by a Siemens generator driven from the water-wheel in a local flour mill, and was fed to carbon filament lamps in the main street.

London, E.C.4. C. HUGHES,
Sales Director,
Siemens Electric Lamps & Supplies, Ltd.

Reversed Polarity

IN your issue of 8th April Mr. L. H. Fenn mentioned a hazard about which the installation and contracting electrician is only too well aware. Public desire to accept the lowest price for electrical work brought the competitive s.p. switch-socket outlet into being, while introduction of the "solid neutral" confirmed it in use. But it is unfortunate that however carefully it may have been wired in the first instance, there is always risk of subsequent connection reversal.

In addition, the more recent practice of eliminating the neutral fuse—for a very good reason of course—has produced a situation in which polarity reversal can make it possible for the phase to be solid from the incoming service-box fuse.

Exeter. W. N. LAVIS.

MR. FENN voices *un cri du cœur* which should find a ready response from all those concerned for electrical safety. I have long felt (*vide* my letter of 22nd August, 1952, published in the *Electrical Review*) that the only solution to this vexed problem is to make the installation of d.p. switch-socket outlets compulsory.

With all too monotonous regularity the Home Office annually reports fatalities due to reversed polarity in earthed situations. This occurs not only through cross connections at the actual socket outlet, but may also happen when main and circuit alterations take place. I have even found an Electricity Board guilty of this error when effecting a changeover from d.c. to a.c. If this mishap can occur with highly skilled operatives, how much more likely is it to happen with the ubiquitous handyman, who through the ever-augmenting flow of electrical gadgets on the market, is on the increase with his unauthorized extensions?

I.E.E. Regulation 608(k) insists that where reversible plugs and sockets are used the switch on the apparatus shall be of the d.p. type. This is to be commended, but the Regulation should go further and stipulate that in addition all socket outlets should be d.p. I think it is time installation engineers took a definite stand on this issue. I shall write to the I.E.E. Wiring Rules Revision Committee and if sufficient persons follow suit it is likely that the mounting pressure will bring about the necessary change.

Hendon, N.W.4. MICHAEL NEIDLE.

THERE should be no doubt of the importance of Mr. Fenn's query regarding the danger of reversed polarity. The danger is a very real one and applies not only to s.p. switch-socket outlets but to lighting circuits also.

I doubt if Mr. Fenn's suggestion that manufacturers should be encouraged to produce d.p. rather than s.p. switch sockets would supply a satisfactory solution. It is my view that good workmanship by reliable contractors and inspection by the Electricity Boards are the only methods to safeguard the public.

I would assure Mr. Fenn that there is a ruling and that this ruling is legally enforceable. The Commissioners' 1937 Electricity Supply Regulations No. 27 (a) (i) cover this point. The Regulations state that "Undertakers shall not be compelled to commence or . . . to continue to give a supply of energy to any consumer unless they are reasonably satisfied . . . that all single pole switches are inserted in live conductors only."

Llanelly, Carms. J. HARLEY.

Electrical Engineers' Exhibition

THE messages of congratulations I have received from all quarters in connection with the 1955 Electrical Engineers (A.S.E.E.) Exhibition are indeed a great tribute to all who have worked so hard to make this exhibition the most successful of its kind ever held in this country. It is not possible for me personally to acknowledge all of them and therefore, through your columns, I would like exhibitors, visitors, guests and supporters to know we do very much appreciate their kind thought in telling us how pleased they were with the organization and general arrangements made for them and their good wishes for an even more successful exhibition at Earls Court in 1956.

The remarkable success of our exhibitions has undoubtedly been due to the small, efficient and enthusiastic organization we have built up of men who are in close

daily contact with everyday events in the electrical industry. No exhibition could be successful without interesting displays, and I congratulate our exhibitors on the excellence of their equipment. The stand arrangements were without question the best we have seen.

Our policy is to interest, educate and benefit everyone concerned with the installation and use of electrical equipment and I venture to suggest there is no reason why we should not continue hand in hand to further outstanding achievements to the benefit of all working in this great electrical industry which we are proud to serve.

London, W.C.1. J. FLOOD,
Chairman,
Electrical Engineers (A.S.E.E.) Exhibition, Ltd.

Church Heating Installations

MR. C. B. CLELAND appears to have missed the point of my letter, i.e., that it is cheaper to warm the legs and feet of the congregation than to heat a church.

If space heating is the requirement, is it not a little presumptuous to guess the loading from no other information than the area of the floor?

Loughton, Essex. A. R. LASH, M.I.E.E.

Electric Light Fittings

YOUR report on the annual luncheon of the Electric Light Fittings Association in your issue of 8th April gives one the impression that the manufacturers are trying to increase the technical efficiency of the profession while the illuminating engineer who designs the installations is too backward to make the most of scientifically designed products.

The remarks about a diploma or degree encouraging the art of illuminating engineering and leading in due course to the efficient use of fittings, may have been well meant, but they are probably not pleasing to the many present-day illuminating engineers who try to design conscientiously, making the best of the scanty technical information extracted from a few manufacturers. They flatter the manufacturers, the majority of whom have no photometric information on almost the whole of their ranges.

Perhaps we need a more enlightened association which will educate its members in the value of photometric information to consultants, and at the same time do its share of the educational work by emulating the fine example of the lamp manufacturers and setting up an information service. They might even consider setting up a joint photometric laboratory to assist smaller manufacturers.

Greenock. RONALD CROFT, B.SC., A.M.I.E.E.

Silicone Coating of Fluorescent Tubes

IT has been announced in the technical Press that certain manufacturers are now marketing fluorescent tubes with a silicone varnish coating for use in circuits which do not employ starter switches. I am sure that many of your readers must be well aware that this company has been marketing " Atlas Quickstart " fluorescent tubes with silicone coatings under the description " Sylcoated " for the past seven years and has in fact sold several millions with this finish. It would seem, therefore, that what is hailed as a new development is not new at all.

London, W.C.2. H. H. BALLIN,
Technical Sales Manager,
Atlas Lighting Division,
Thorn Electrical Industries, Ltd.

Technical Training

IN " Views on the News " in your issue of 15th April " Reflector " comments on " one of the first applications of the term sandwich system " made by Mr. Lineham in 1905.

May I point out that Faraday House College was founded in 1889 with the curriculum of the sandwich system, of alternate years in college and in works.

London, W.C.1. W. R. C. CODE-ADAMS,
Principal,
Faraday House Electrical Engineering College.

Incorporated Plant Engineers

THE theme of the eighth annual conference of Incorporated Plant Engineers, to be held at the Hotel Majestic, St. Annes-on-Sea, on 18th to 20th May, will be set by an address, " Plant, People and Prosperity " by Mr. E. E. Butten, chairman of Personnel Administration, Ltd. Mr. Butten's paper will cover a wide field, including the advent of " automation " and its impact. He will discuss at length the growing importance and responsibility that automation will bring to the plant engineer, and the human problems such as redeployment of labour and staff that will have to be faced. The paper will consider also the latest developments in management techniques and how they can help the plant engineer.

The conference programme provides also for four discussion groups on subjects widely separated in nature but of equal interest and value to all sections of industry at the higher executive level. One group will discuss electrical safety in factories on which there will be a short paper by Mr. H. W. Swann, formerly H.M. Senior Electrical Inspector of Factories. A second group will consider the question " Can work study and its incentives be applied to maintenance?" the opening paper being by Mr. A. J. Speakman, head of the Work Study Unit of the British Productivity Council. A third group will study " Is there a future for tracked earth-moving plant in view of the developments in rubber-tyred earth-moving plant?" A fourth group will discuss the important topic of " The impact on the plant engineer of new engineering materials." At the conference dinner on 19th May the principal speaker will be Sir Bruce White.

Summer School on Computers

A four-week course on digital and analogue computers and their application to electrical engineering problems will be held at Imperial College, London, from 31st May to 24th June. The course is intended to acquaint electrical engineers with the computing facilities that are becoming available, to introduce them to the methods used for the solution of typical engineering problems, and to instruct them in the presentation of problems for computation.

The course is being held by the Department of Electrical Engineering Imperial College with the help of the Mathematics Department of the College, members of the staff at the National Physical Laboratory and various firms and organizations engaged in computer manufacture and application.

Further particulars can be obtained from the deputy registrar, City and Guilds College, Exhibition Road, London, S.W.7. The number attending the course will be restricted to about twenty.

INDUSTRIAL NEWS

Canadian Orders for Britain

The placing of contracts in this country valued at several million dollars by the buying mission of the Vancouver Board of Trade (now in this country) was referred to by Mr. H. Walters, leader of the mission, at a luncheon held in London last week, arranged by the Canadian Chamber of Commerce in Great Britain. According to the *Manchester Guardian*, Mr. Walters said that by placing orders here Canada hoped to stimulate orders from this country so that the total volume of trade could be expanded. Each of the fifty-one Canadian business men making up the mission intended to buy and none would place orders for less than $50,000 worth of goods per annum.

The largest single order has been placed by the British Columbia Electric Co., Ltd. (which Mr. Walters represents), with British Insulated Callender's Cables, Ltd., for the manufacture and installation of 77 miles of submarine power cable.

As we reported in our issue of 27th August last, British Insulated Callender's (Submarine Cables), Ltd., was formed by British Insulated Callender's Cables, Ltd., and W. T. Glover & Co., Ltd., to specialize in the design and manufacture of submarine power cables, and the factory at Trafford Park will be occupied for most of this year manufacturing the 138 kV 0·35 sq in gas-filled submarine cable for the British Columbia Electric Co.

Prospects for Electrical Manufacturers

Total exports of electrical goods by British manufacturers rose to about £218 million in 1954 said Sir John Dalton, vice-president of the British Electrical Power Convention, at a luncheon given by the Convention in London on 15th April. This compared with a total of £23 million in 1938 and £212 million in 1953. Sir John said that no other nation had launched a nuclear programme on the same scale as Britain. In the next ten years we would be spending £300 million on the building of nuclear power stations, capable of supplying from 8 to 11 per cent of the maximum output of the Central Electricity Authority. The prospects for the industry were very bright.

Mr. J. Eccles, deputy chairman, C.E.A., was asked whether electrons generated by nuclear reaction could be used direct as electricity. He explained that microwatts had been produced by direct nuclear action but it was unfortunately a direct current. He thought the use of electricity direct from nuclear reaction was "a goodish way off," but he hoped that we would not be prevented as industrialists from trying to harness nuclear reaction for industrial purposes.

Large Transformer with Aluminium Windings

What is believed to be the world's largest power transformer with aluminium windings is now under construction in the St. Catharine's, Ontario, plant of the English Electric Co. It will play an important part in the expansion now under way of the Kitimat, British Columbia, smelting plant of the Aluminum Co. of Canada. The current expansion programme, started in October, 1954, will add 60,000 tons to Kitimat's present aluminium production capacity of 91,500 tons a year by the end of 1956. A further expansion now authorized for completion in 1959 will bring the total production capacity to 331,500 tons a year.

The English Electric unit will transform 70,000 kVA from 275 kV to 13·2 kV. The total length of the aluminium conductor, rectangular in cross section, will be over 42 miles. The h.v. winding conductor will be insulated with an appropriate number of paper layers and the l.v. conductor will have an extra heavy "Formel" coating. The total weight of the aluminium conductors will be approximately 11,000 lb. Alcan already has a number of aluminium-wound transformers in operation in various places, and all have given completely satisfactory service. They range in size from 220 to 20,000 kVA. Aluminium was selected for the winding material of the new 70,000 kVA unit in order to provide an opportunity for a major electrical manufacturer to study the design and economics of aluminium in a large power transformer. This will provide practical data required for the future development of this aluminium application.

N.Z. Lamp Tariff Inquiry

The *Board of Trade Journal* reports that the New Zealand Board of Trade is to hold a public inquiry, commencing on 28th June, into the rates of duty to be imposed on "incandescent filament electric lamp bulbs and electric lamps not being peculiar to surgical use." At present Great Britain enjoys a considerable preference over other countries. During the inquiry the Board will consider the desirability of reclassifying lamps for the purpose of the Customs tariff. Notes for the guidance of witnesses in preparing evidence for the inquiry are available from the Export Services Branch, Board of Trade, Room 601, Lacon House, Theobalds Road, London, W.C.1 (telephone: Chancery 4411, Ex. 681). British interests proposing to submit evidence are asked to advise the Commercial Relations and Export Department, Horseguards Avenue, London, S.W.1, of their intentions.

Handling of Materials

Out of a total wage bill for British manufacturing industries of about £2,500,000 a year one-sixth to one-third can be attributed to handling. Accidents causing loss of time cost industry in one year alone £70 million; 28 per cent of such accidents were due to handling. Elimination of unnecessary handling could raise productivity 15 per cent without any change in the existing productive machinery. These facts are included in "The Handling of Materials," which has been published (price 9d) by the British Productivity Council, 21, Tothill Street, London, S.W.1, as No. 3 in its Action Pamphlets series. The pamphlet sets out the advantages to be gained from good handling practices and the principles which should be followed. Brief details are also included of a selection of equipment, and an appendix contains notes of printed matter and films that may be useful for further information.

Electrical Industries Club

Members of the Electrical Industries Club are reminded that the May luncheon has been postponed from the 10th to the 17th on account of the E.D.A. annual luncheon which takes place on 10th May.

Radio-Controlled Locomotive

It is reported by *Reuter* from Paris that an electric locomotive of the type which recently established a world speed record of 205 m.p.h. has been driven by radio remote control. The distance covered was 11 miles, on the line from Paris to Le Mans. The 70-ton locomotive (BB9003) reached a speed of 60 m.p.h. (the highest permitted on the particular stretch of track) in three minutes. This is believed to be the first time that a locomotive has been driven by remote control.

G.E.C. Scholarship Scheme

Two scholarships will in future be awarded annually by the General Electric Co., Ltd., to people of outstanding promise in its home establishments or associated companies. Examples of the work for which these scholarships are intended to provide are degree courses in electrical or mechanical engineering, general or

special sciences, post graduate research, and courses in more specialized subjects such as production engineering and glass technology. Studies in management or commerce will also be acceptable. No restrictions as to a candidate's age or choice of subject are envisaged in the scheme, provided that he has already shown that he possesses the ability and personal qualities which indicate with reasonable certainty that he is destined to take up responsible work in the future, and that there is every prospect of his having a useful and satisfying career in the direction of his choice within the company.

Scholars will undertake to remain with the company for three years after the completion of their course, and will spend an agreed period in one of its establishments during vacations.

F.B.I. Report

The annual report for 1954 of the Federation of British Industries presented to the annual meeting held on Wednesday last records its wide range of activities at home and abroad during the past year. The membership at the end of the year was 6,951 firms (a net gain of 200) and 286 trade associations. The report includes a reference to the Herbert Committee set up to inquire into the organization of the electricity supply industry to which the Federation submitted a memorandum which included a number of recommendations concerning industrial tariffs and a proposal for the setting up of a National Consultative Council to consider matters, in particular generation, at present outside the scope of Area Consultative Councils. The representations were supported by oral evidence in December, when additional evidence was asked for on the sale to Area Boards of electricity generated by industrial plants and on the effect of electricity charges on the location of new factories. Information was being collected at the end of the year. A further invitation was received to give evidence on the organization of the supply side of the electricity industry, and this too was being studied.

Economic and taxation policy, productivity, transport, valuation and rating, monopolies and restrictive practices, and fuel and power are among the many other subjects covered by the report.

Wire Covering Machinery

Finney Presses, Ltd., a member of the Metal Industries group of companies, announces that it has been granted licence to manufacture in Britain the plastic, rubber and continuous vulcanizing machinery, which covers a full range of ancillary equipment, including those items specially developed for the wire insulating industry, produced by Davis-Standard Sales Corporation of Mystic, Connecticut, U.S.A. The company is to market this range of machinery in Europe and throughout the sterling area. Mr. J. Trevor-Jones, managing director of Finney Presses, Ltd., who has recently returned from the United States after completing negotiations in this connection, informs us that his company has represented David-Standard in this country for some time past and will continue in this capacity until completion of new tooling necessary for the production of the equipment at the Birmingham works. Mr. H. M. Whitcut is shortly to join Finney Presses, Ltd., to promote this phase of the company's activities.

Siemens Southampton Depot

The new branch in West Bay Road, New Docks, Southampton, of the Siemens Brothers group of companies was formally opened on 31st March, replacing premises destroyed by enemy action. The opening ceremony was performed by Mrs. R. P. Biddle, wife of the docks and marine manager, Mr. R. P. Biddle, who attended with representatives of dockland departments and industrial and shipping firms. Mr. Cecil Hughes, sales director of Siemens Electric Lamps & Supplies, Ltd., introducing Mrs. Biddle, said that the object of the depot was to give service to the industrial, commercial, and domestic life of the town and docks and surrounding areas.

The new branch will be concerned with all the group's products, including marine supplies and equipment in addition to lamps and lighting, telephone, cable and communication apparatus. It will cover the Hants, Dorset, and Isle of Wight areas, and will be under the area managership of Mr. A. Shaw. A lunch at the Polygon Hotel, Southampton, followed the opening ceremony, when Mr. Biddle paid tribute to all concerned with the development of the new depot.

£81 million for Telephones

The first public engagement of the new Postmaster-General, Dr. Charles Hill, was the opening of the Rippleway automatic telephone exchange at Dagenham. Dr. Hill said that in 1951 £50 million was spent on telephone development; this increased to £70 million in 1954 and next year it would rise to £81 million.

In London alone there would be 21 new telephone exchanges this year and 24 next year. This same rate of progress was taking place in the rest of the country. In 1951-52 the Post Office was putting in seven million miles of pairs of wires a week. In 1954-55 the figure rose to ten million miles and next year it would go up to fifteen million miles a week. There were now 6,500,000 telephones, twice as many as before the war. The demand for telephones continued to increase and in the first quarter this year reached a record level.

The Post Office had completed trials of a scheme by which operators at the Continental exchanges in London could dial certain Continental numbers direct. It was hoped in the latter part of this year to convert the London-Amsterdam route to automatic working, and within two or three years the service, with the majority of the more important West European countries, would be operated on this basis.

Baird Memorial

Nearly £2,000 has been subscribed in Scotland at the initiative of the Royal Technical College, Glasgow, to commemorate John Logie Baird, inventor of television, who was a graduate of the College. At a luncheon held by the Radio Industries Club on 6th April, Mr. C. Wilson, president of the Club, handed over a cheque for £450 to Dr. Anderson, principal of the College, as a contribution from the Scottish trade. Dr. Anderson said that the money so subscribed would be used at the discretion of the Governors of the College. It is anticipated that it will provide for three methods of continuous recognition: a memorial plaque; an annual prize in the Department of Electrical Engineering in the College; and a John Logie Baird Memorial Lecture.

Prices of Materials

In the accompanying table we give the basis prices of the more important materials used in the electrical industry. The figures given are the selling prices and are those quoted on Monday last.

ALUMINIUM Ingots	ton £163 0s 0d
COPPER, H.C. Electro	ton £330 0s 0d
Fire Refined 99·70%	ton £329 0s 0d
Fire Refined 99·50%	ton £328 0s 0d
COPPER Tubes ..	lb 3s 0½d
Sheet	ton £382 5s 0d
H.C. wire and strip ..	ton £354 10s 0d
LEAD, English	ton £105 5s 0d
Foreign	ton £104 0s 0d
MERCURY	flask £108 10s 0d
TIN, block (English) ..	ton £722 0s 0d
ZINC, G.O.B. Foreign	ton £89 10s 0d
Electrolytic	ton —
BRASS Tubes (solid drawn)	lb 2s 5½d
Sheet	ton £306 0s 0d
Wire	lb 3s 0½d
PHOSPHOR BRONZE Wire	lb 4s 6½d
PLATINUM	oz £29 0s 0d
RUBBER, No. 1 R.S.S. spot	lb —

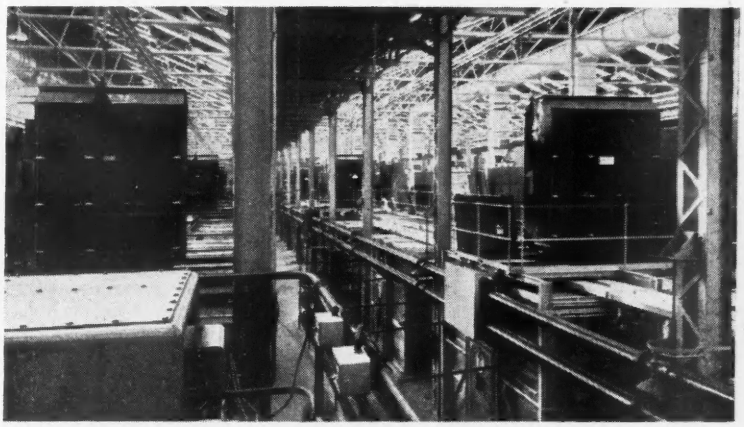
The indices for materials used in the mechanical engineering and electrical machinery industries, according to the *Board of Trade Journal*, continued their upward movement with increases in March of 0·2 and 0·5 per cent, the figures being 164·2 and 184·2 respectively. The further rise between February and March was due to higher prices for various brass and copper items.

Change of Address

The address of the National Smoke Abatement Society is now Palace Chambers, Bridge Street, London, S.W.1 (telephone: Trafalgar 6838-9).

Transformers for Atomic Energy Works

The accompanying picture shows a number of special Denis Ferranti transformers installed at the Capenhurst Works of the United Kingdom Atomic Energy Authority. The transformers are part of a large number of 550 kVA, 6,600 V, 50 c/s, 3-phase transformers with natural air-cooling, fire-proof cases and lever-operated ventilators. Provision is included for injecting inert gas in case of fire and locking doors give easy access for tap-changing and cleaning. As no forced draught is permissible, to ensure the utmost reliability the transformers are much larger than their rating would suggest.



Denis Ferranti transformers at the United Kingdom Atomic Energy Authority's Capenhurst Works

Copper Sales

The Board of Trade announces that it has decided to sell up to about 45,000 tons of electrolytic copper over the rest of this year. Arrangements for the sale of part of this have already been made with the Rhodesian producers and their sales agents, and it is proposed to enter into early discussions with the trade about the disposal of the remainder. The intention is that so far as practicable the copper will be delivered and priced at an even rate. This copper is from the trading stocks remaining in the Government's hands after private trading was restored in 1953. The copper already sold is of Rhodesian brands.

Coal Utilization

The British Coal Utilization Research Association at Leatherhead is holding open days on 8th, 9th and 10th June, during which the work of the laboratories will be available for inspection by visitors. Wednesday, 8th June, will be reserved for members and their friends. A wide range of exhibits is being prepared to show the scope of the research programme on coal utilization which is now being carried out at Leatherhead.

Poultry House Display

An attractive display has been produced by Venner, Ltd., for use at agricultural and livestock shows, featuring their "MPDC" time switch for controlling extended "daylight" in poultry houses. By means of a fast running synchronous clock mechanism the model contracts 24 hours into a cycle of 45 seconds, showing bright lighting following daylight, a short dim period before the night shut down, and a return to bright lighting at early morning.

A Venner poultry house display

Bath and West Power House

The special prefabricated power house which was used for the first time at the Bath and West Show at Exeter last summer has been re-erected and equipped in readiness for this year's Show at Launceston, Cornwall, at the beginning of June. Three 400 kW Lister-Blackstone diesel alternator sets will supply all the light and power required throughout the 110-acre showgrounds (80 acres at Exeter) and, in addition, by means of a waste heat recovery unit, hot water will be available to all herdsmen, exhibitors and the caterers. An additional feature of the equipment in the power house this year is a small generating set which will carry the reduced night load without calling on the main plant. This set comprises a Lister FR6 radiator cooled diesel engine mounted on a combined baseplate and direct coupled to a MacFarlane "Magnicon" self regulating alternator of 28 kW, together with an exhaust water heater. The set is erected on anti-vibration mountings. The Lister FR6 develops 48 h.p. at 1,500 r.p.m. The three alternator sets will be Blackstone ERS8 diesel engines direct coupled to E.C.C. 400 kW, 500 kVA, 0·8 p.f. 3-phase, 420/240 V, 50 c/s, four-wire alternators. The connected load will exceed 600 kW.

The observation balcony running the length of the building will again provide an illuminated display which will assist visitors to understand the process of generating electricity and providing hot water from diesel engines. A working model of a generating set will provide the centre-piece of the display which will also include an exhibition of photographs demonstrating the many uses of the modern diesel engine and electrical equipment. In addition to R. A. Lister & Co. and Blackstone & Co., other electrical companies co-operating in this project are the Electric Construction Co., Ltd. (alternators and switchboards); G. N. Haden & Sons, Ltd. (hot-water equipment and distribution); Drake & Gorham, Ltd., and G.M. Engineering Co., Ltd. (electrical installations and show-ground distribution); British Insulated Callender's Cables, Ltd. (overhead line equipment); and General Electric Co., Ltd. (lighting equipment in power house).

Dielectric Heating in the Furniture Industry

The Furniture Development Council has recently issued an information report (No. 11) on dielectric heating for setting adhesives. This is intended to explain the principles and practice of the method and to guide furniture makers in using the most efficient and convenient system for each particular job. The problem involved is the heating of the glue-line between two pieces or layers of wood so that the setting period of the glue is reduced. For example, with a particular glue the setting time is 350 minutes at 65 deg F and 2·2 minutes at 195 deg F. The great advantage of dielectric heating is that, owing to the difference in permittivity between the glue and the wood, it is possible for the glue alone to be heated and for a comparatively high temperature to be achieved without burning the wood.

The report contains data concerning the use of the method with all types of wood normally used and the common adhesives; safety against fire

and shock; and costing data. A glossary of the usual terms employed is given. It is by Ian Jones, B.Sc., and is issued by the Furniture Development Council, Technical Information Service, 11, Adelphi Terrace, London, W.C.2.

Emergency Radio Equipment

On 3rd April it was reported that the Marconi 20 kW transmitter at the Cyprus broadcasting station at Nicosia had been damaged by saboteurs and was out of operation. An emergency plan on an around-the-clock basis was rushed into action at Marconi's Chelmsford works. Forty-eight hours later, a complete 2 kW broadcasting transmitter was in packing cases ready for shipment. The transmitter was flown to Cyprus the next day, accompanied by Marconi engineers.

A.S.E.E. Year Book

The value of the 1954-55 edition Year Book of the Association of Supervising Electrical Engineers has been enhanced by the inclusion of a technical guide of some seventy-four pages. This includes a list of the principal regulations governing electricity supply and electrical installations, numerous tables and data on motors, transformers, lighting and heating, and electrical terms and definitions. The section dealing with the activities of the Association covers such matters as its objects, benefits, competitions, diploma scheme, employment bureau, as well as listing the officers of the Association, the Executive Council and Committees.

Works Transport Two-Way Link

Believing that only by maintaining continuous direct speech contact can internal works transport be deployed with maximum efficiency, Marconi's Wireless Telegraph Co., Ltd., has equipped six of its battery-electric industrial trucks with two-way v.h.f. radio. This small fleet has been in daily operation for the last twelve months in the large new Marconi factory now coming into production at Basildon, Essex. During this period of establishment the ability to route a truck from department to department and from job to job as the need arose has proved of great value. No time is lost by drivers reporting back for fresh instructions and as the whereabouts of each truck is always known, transport can be instantly diverted in an emergency.

The fleet consists of three Lansing Bagnall 2-ton platform trucks, two 1-ton "Conveyancer" and one 2-ton "I.T.D." fork-lift trucks. The radio equipment, of Marconi manufacture, works from a 12 V supply drawn from the truck's "Exide-Ironclad" traction battery via a ballast resistor—a system which equalizes the load on the cells. The installation comprises a transmitter/receiver unit operating within a frequency range of 156-184 Mc/s, a vibrator power pack, control unit and quarter-wave dual-purpose aerial assembly. The receiver on each truck is permanently switched on so that messages broadcast by the transport controller are simultaneously heard by all drivers. Experience has shown that the truck's working duration per charge is not noticeably affected by this small but continuous drain on the battery's capacity.

Works Visit

Some 160 members of the Institution of Locomotive Engineers recently visited the Witton Engineering Works of the General Electric Co., Ltd. At a luncheon at the Midland Hotel, Birmingham, Mr. J. J. Gracie, a director of the G.E.C., welcomed the visitors and Mr. A. Campbell, president of the Institution, replied, after which the guests proceeded to the works in six coaches. With senior members of the staff acting as guides, the visitors were shown round the various factories and saw generating plant, transformers and switchgear in course of construction as well as rectifier substation equipment for traction service, and motors, generators and control gear for different types of rolling stock. The tour was followed by a buffet tea at the Magnet Club.

Refrigerator Survey

In the domestic electrical equipment survey dealing with refrigerators (*Electrical Review*, 8th April) the finish of all three G.E.C. models was given as white stoved enamel cabinet and plastics on steel interior. The foregoing applies only to the DE.31 refrigerator. Both the DE.52 and DE.81 have similar cabinet finishes but the interiors are of white vitreous enamel resistant to acids and non-toxic.

Trade Announcements

Berry's Electric, Ltd., has appointed Mr. J. E. Oakley as its West Midlands representative. He was previously with Electrical Components, Ltd., Birmingham, in charge of electric lighting fittings and domestic appliances. Mr. B. S. Powell has been appointed East Midlands representative. He was a senior sales assistant with the Midlands Electricity Board.

H. W. Field & Son, Ltd., have appointed Stevenson & Turner, Ltd., 1-17, West Street, Smithfield, Belfast, as sole distributors in Northern Ireland for their fluorescent products. Carlile & Co., Ltd., Drury Street, and Walsall Conduits, Ltd., Lower Kevin Street, Dublin, have been appointed main distributors in Eire.

New Era Industries (Tottenham), Ltd., 10, St. Loys Road, Tottenham, London, N.17, has set up a new department for users and contractors to deal with fluorescent lighting fittings specially designed and made for particular requirements.

Mr. H. E. Bond, late of Oliver Pell Control, Ltd., has now joined the electrical engineering division of **Jenson & Nicholson, Ltd.,** as an outside representative.

Mr. C. A. Moyles has been appointed South London and South Eastern Area Board representative for **Nettle Accessories, Ltd.,** Manchester. He was previously with T.M.C.-Harwell (Sales), Ltd.

CATALOGUES & LISTS

ACCESSORIES.—Four leaflets describing switches for domestic appliances and other applications, and lighting fittings and accessories for public service vehicles and coaches. —**D. H. Bonnella & Son, Ltd.,** West Hill, Hoddesdon, Herts.

CONDUIT FITTINGS.—Priced catalogue covering the company's range of pressed steel conduit fittings, switchboxes, etc. (13).—**F. C. Blackwell & Co., Ltd.,** Great Crosby, Liverpool, 23.

FURNACES.—Catalogue of the company's "OKM 4" three-phase outdoor oil circuit breaker for 33 kV service.—**English Electric Co., Ltd.,** Switchgear Sales Dept., Stafford.

INSTRUMENTS.—Technical leaflet giving details of a new series of hermetically sealed instruments—Series H.—**Record Electrical Co., Ltd.,** Broadheath, Altrincham, Cheshire.

LIGHTING FITTINGS.—Leaflet dealing with a range of bulkhead lighting fittings.—**Dorman & Smith, Ltd.,** Ordsal Electrical Works, Manchester, 5.

Eight leaflets describing new additions to the company's range of lighting fittings.—**Falk, Stadelmann & Co., Ltd.,** 91, Farringdon Road, London, E.C.1.

Priced 19-page catalogue covering a range of carved wood period lighting fittings.—**Payne & Penny, Ltd., and John Bowen Fittings, Ltd.,** 556-586, Kings Road, Chelsea, London, S.W.6.

A 24-page catalogue with separate price list covering a range of modern lighting fittings, including glass wall and ceiling types, and industrial watertight patterns—**Ascog, Ltd.,** 44, Theobalds Road, London, W.C.1.

SOLDERING EQUIPMENT.—Illustrated leaflet dealing with a "super-speed" lightweight soldering iron.—**Enthoven Solders, Ltd.,** 89, Upper Thames Street, London, E.C.4.

Technical publication dealing with solders and fluxes for cable jointing (No. 6).—**Fry's Metal Foundries, Ltd.,** Merton Abbey, London, S.W.19.

SWITCHES.—Brochure dealing with a selection of the "Delta" range of pressure and vacuum switches.—**Delta Technical Services, Ltd.,** Fairfield Road, Kingston-on-Thames, Surrey.

SWITCHGEAR.—A 100-page illustrated and priced catalogue covering the company's complete range of switch and fuse gear, socket outlets, switch sockets and semi-standard products.—**Wm. Sanders & Co. (Wednesbury), Ltd.,** Falcon Electrical Works, Wednesbury, Staffs.

VACUUM CLEANERS.—Brochure (5302) describing the company's No. 4X industrial vacuum cleaner and a 32-page catalogue (5010) dealing with industrial vacuum cleaners, flue dust collecting plant and turboblowers and exhausters.—**Sturtevant Engineering Co., Ltd.,** Southern House, Cannon Street, London, E.C.4.

WATER HEATERS.—Leaflet on the company's new 1½ gal storage water heater.—**Hotpoint Electric Appliance Co., Ltd.,** Crown House, Aldwych, London, W.C.2.

WIRES.—Technical booklet dealing with the company's "MS.1360" silicone enamelled wire.—**Midland Silicones, Ltd.,** 19, Upper Brook Street, London, W.1.

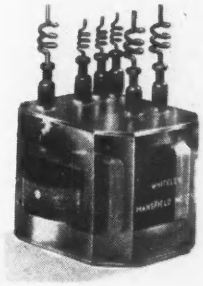
RADIO and ELECTRONIC COMPONENTS

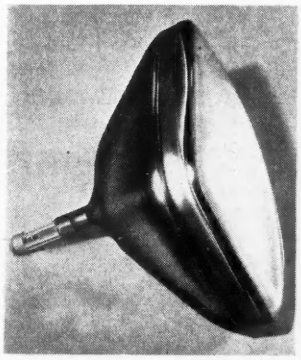
Twelfth R.E.C.M.F. Exhibition

THERE were 140 exhibitors (a record number) at the twelfth British Radio Component Exhibition held at Grosvenor House, London, this week (19th-21st April). They included about ten companies which had not previously taken part in this annual private exhibition organized by the Radio and Electronic Component Manufacturers' Federation. This exhibition is generally acknowledged to be of real value to the technical visitor. It is bright and compact and crowds into the space of a few thousand square feet a representative display of the components of an industry which employs 40,000 people and produces about a thousand million radio and electronic components, valves, instruments and accessories every year. All the exhibits are of British manufacture and include components for the radio, television, electronic and telecommunication industries, as well as gramophone components, valves and test gear.

As one would expect, there were many exhibits relating to the development of television all over the world and its imminent expansion in this country to the higher frequencies. Several firms, such as Sidney S. Bird & Sons, Ltd., and the Plessey Co., Ltd., displayed multi-channel tuning units for television receivers as well as new types of valves and cathode ray tubes for the new British television frequencies. There were also quite a few convertor units for existing Band I receivers to enable them to operate on Band III when transmissions begin in September. Apart from germanium diodes and transistors, Standard Telephones & Cables, Ltd., showed "Brimar" valves for the proposed f.m. transmissions and for tunable television receivers covering the existing channels and the proposed Band III channels. New valves included a cascode r.f. amplifier and a triode-pentode frequency changer. A 17in cathode ray tube was also shown which incorporates an internal focus electrode, thereby eliminating the need for external focus magnets and controls.

Right: Whiteley "C" core transformer moulded in "Araldite"





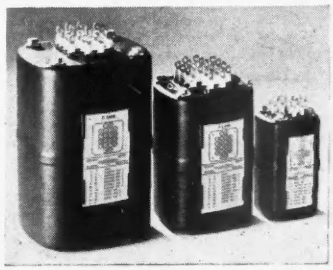
Left: Mullard 21in 90 deg television picture tube

The new valves shown by the General Electric Co., Ltd., included types for use in f.m./a.m. radio receivers and in dual band television receivers. A new triode with an indirectly heated cathode has been designed for use in pairs in public address amplifiers where output powers of 175 W are required. The company also introduced three new semi-conductor devices; a medium power germanium p-n junction rectifier, a high frequency point contact transistor and a junction transistor.

Among the many valves and cathode ray tubes shown by Mullard, Ltd., was a 21in tube for 90 deg scanning. It is about 3in shorter than a 70 deg tube with the same screen diagonal, which enables the front-to-back cabinet measurement of a television receiver to be kept reasonably small (21in), a factor of great importance in table models. Other exhibits included magnetic materials, capacitors and temperature dependent resistors.

The valves for use in f.m. receivers shown by the Edison Swan Electric Co., Ltd., included a grounded-grid triode suitable for use as an r.f. amplifier, a series run version of the same valve, and a double diode for use as a ratio detector. A full range of television tubes including 21in rectangular types with 70 deg and 90 deg scanning angles was also shown, together with a number of items of special equipment such as low frequency oscillators, portable recording equipment and stabilized power units The company also illustrated on its stand the application of fluorocarbon resins, polytetrafluoroethylene (p.t.f.e.) and polymonochlorotrifluoroethylene (p.t.f.c.e.). Besides a wide range of components utilizing these materials many new developments in the technique of fabricating these plastics were displayed.

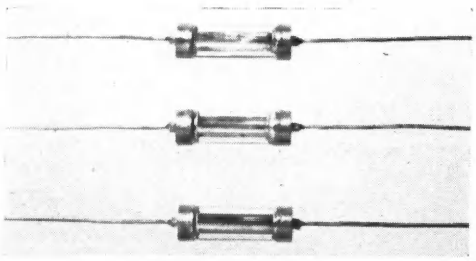
Right: Parmeko "Saturn" transductors



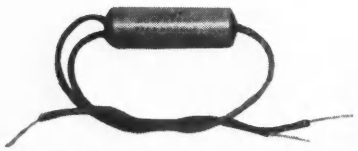
Left: Partridge open type "C" core transformer

The English Electric Co., Ltd., emphasized a new range of industrial valves which has been developed for r.f. heating. Also on view was a range of "C" cores for single-phase transformers and chokes, and "E" cores for three-phase transformers and hermetically sealed open type and cast resin transformers incorporating "C" cores. The comprehensive range of valves displayed covered the needs of broadcasting, radar, television and v.h.f. links. Associated Electronic Engineers, Ltd., showed a wide selection of power and audio transformers on interservice lamination and "C" cores, hermetically sealed transformers and cast resin transformers. Many examples of potted components were displayed by the Whiteley Electrical Radio Co., Ltd.

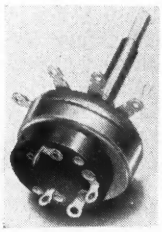
A new series of high fidelity output transformers of open "C" core construction by Partridge Transformers, Ltd.,



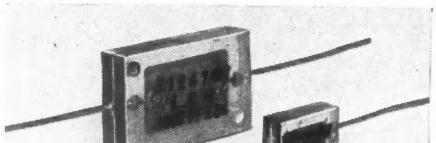
Welwyn metal film resistors



Dubilier interference suppressor



Right: Egen concentric switch potentiometer



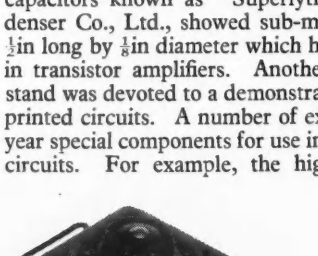
" Catacon " moulded silvered mica capacitors

was shown alongside a new series of resin cast, line and microphone transformers. A special display was made by Parmeko, Ltd., of its " Saturn " range of transductors for magnetic amplifier applications. The company also introduced a series of transformers for photo printed circuits and examples of mains transformers, chokes and output transformers illustrating this application were exhibited. Resin cast transformers and chokes for a diversity of requirements were displayed by Gresham Transformers, Ltd., and the Woden Transformer Co., Ltd. The range of continuously variable auto-transformers made by the British Electric Resistance Co., Ltd., has now been supplemented by the " Readavolt," a more comprehensive type, which includes a voltmeter that can be switched either into the input or output sides of the regulator, outlet socket, insulated terminals and fuse. Transformer laminations of all kinds were to be seen on the stands of such companies as Magnetic & Electrical Alloys, Ltd., Geo. L. Scott & Co., Ltd., and the Telegraph Construction & Maintenance Co., Ltd.

The last company also had cables produced by a modified process giving a very substantial improvement in non-microphonic characteristics. A further introduction was a range of television downlead cables having expanded polythene dielectric. British Insulated Callender's Cables, Ltd., showed r.f. cables, miniature multi-way cables, television camera cables and polythene couplers, television relay cables, a new range of television downlead cables insulated with cellular polythene, and winding wires. W. T. Henley's Telegraph Works Co., Ltd., also displayed a comprehensive range of cables and connecting and winding wires as well as the new " Superthane " wire. The self-fluxing properties of this enamelled wire will undoubtedly appeal to all those who are faced with soldering problems. The diversity of winding wires shown by Connollys (Blackley), Ltd., included enamelled wires with various properties including wires for quick soldering, high temperature, high solvent resistances and self-bonding properties. Apart from a comprehensive range of polythene and p.v.c. insulated wires and cables Duratube & Wire, Ltd., showed multi-colour extruded insulations on connecting wires and flexibles. This new development is interesting since the colours are extruded direct on to the wire and are not colour printed, thus giving permanency.

The exhibit of Fine Wires, Ltd., comprised textile covered winding wires, both single and bunched conductors, with special emphasis on wires for wave winding. The display of F. D. Sims, Ltd., included wires and strips with practically every type of covering, while the London Electric Wire Co. & Smiths, Ltd., showed insulated winding wires, bare and insulated flexibles and braids, connecting wires, aerial wires and earth rods, Litz wires and insulated resistance wires. Other wires and cables and insulating sleevings were shown by the Reliance Electrical Wire Co., Ltd., Suflex, Ltd., H. D. Symons & Co., Ltd., and the Vactite Wire Co., Ltd., while insulating materials of various types were displayed by such firms as Aero Research, Ltd., Bakelite, Ltd., Geo. Bray & Co., Ltd., British Moulded Plastics, Ltd., Bullers, Ltd., H. Clarke & Co. (Manchester), Ltd., Creators, Ltd., Thomas De La Rue & Co., Ltd., Long & Hambly, Ltd., Micanite & Insulators, Ltd., the Minnesota Mining & Manufacturing Co., Ltd., Moulded Products, Ltd., the Mycalex Co., Ltd., Thermo-Plastics, Ltd., Tufnol, Ltd., and the United Insulator Co., Ltd. Cable binding and identification sleeves, injection mouldings, crimped cable terminals, cable securing devices, sealing glands and pressure bungs, and plastic coated metal parts were shown by Hellermann, Ltd.

Apart from a new range of low leakage electrolytic capacitors known as " Superlytics," the Telegraph Condenser Co., Ltd., showed sub-miniature electrolytics only $\frac{1}{2}$in long by $\frac{1}{8}$in diameter which have been designed for use in transistor amplifiers. Another part of this company's stand was devoted to a demonstration of the applications of printed circuits. A number of exhibitors had on view this year special components for use in conjunction with printed circuits. For example, the high-stability low-loss sub-



Left: Berco " Readavolt " continuously variable auto-transformer

Right : Westinghouse contact cooled rectifiers

Left: "Avo" valve characteristic meter

Right: Belling & Lee "Airfuse"

miniature moulded silvered mica capacitors shown by the Dubilier Condenser Co. (1925), Ltd., are ideally suited for printed circuit applications. This company also displayed a range of interference suppressors, including the latest types for use with industrial appliances, and a series of feed-through capacitors capable of providing suppression over all frequencies up to and including Band III. Special chokes for Band III television suppression were also shown.

A high permittivity ceramic, known as "Faradex H" (K=3,200) is being produced on a large scale for by-pass capacitor manufacture by Steatite & Porcelain Products, Ltd. This company also makes "Frequentite S," a material of extremely low dielectric loss (tan $\delta = 0.0002$), which is attracting increasing interest. The mechanical properties and freedom from porosity of this material render it particularly suitable for vacuum applications such as u.h.f. valve envelopes, magnetron windows, etc. Daly (Condensers), Ltd., showed a range of midget aluminium tubular electrolytic capacitors suitable for temperatures up to 85 deg C which by new techniques offer current capacity and voltage values in aluminium cans with diameters of $\frac{3}{8}$in.

Besides their well-known silvered mica capacitors, Stability Radio Components, Ltd., showed a range of ceramic tubular capacitors rated at 100 deg C. These are inexpensive, robust and fully insulated components which cannot be damaged by prolonged contact with a soldering iron.

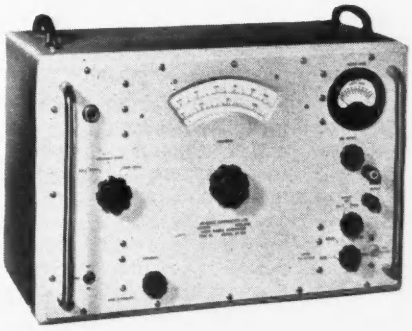
The capacitors shown by the Telephone Manufacturing Co., Ltd., included many new metallized paper, polystyrene and American styled components for both civil and military use. The "Catacon" range of moulded silvered mica capacitors made by the London Electrical Manufacturing Co., Ltd., are now available for operation from − 40 deg C to + 100 deg C with values from 100 pF to 250,000 pF.

Apart from capacitors of various types, Erie Resistor, Ltd., displayed high stability resistors, carbon and wirewound resistors, carbon potentiometers and printed circuits. The potentiometers and resistors shown by Morganite Resistors, Ltd., included the new type S insulated $\frac{1}{2}$ W resistor and the type P sub-miniature resistor which has a rating of $\frac{1}{10}$ W and is intended for special applications such as in guided missiles, airborne equipment, etc. New items shown by Welwyn Electrical Laboratories, Ltd., included "Victricon" capacitors which will maintain an insulation resistance in excess of $10^{10}\Omega$ when operating at an ambient temperature of 150 deg C, and metal film resistors which can also operate at high temperatures. The latter consist of a metal film deposited on glass and a component measuring $1\frac{1}{8}$in long by $\frac{5}{16}$in diameter can have resistance values up to 1 MΩ at a tolerance of one per cent.

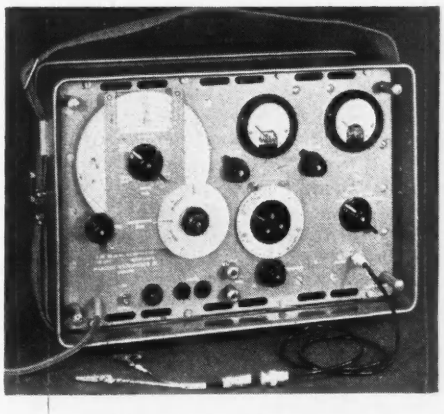
Among the new products shown by Egen Electric, Ltd., was a range of dual potentiometers with concentric operating spindles and a series of concentric switch potentiometers. The last mentioned offer the advantage of an independently operated switch and this component when applied to a typical modern television receiver reduces day-to-day operation to simply switching off, while the potentiometer can remain pre-set in its optimum position. Resistors of diverse types were shown by the Zenith Electric Co., Ltd., Electrothermal Engineering, Ltd., Electronic Components Ltd., Erg Industrial Corporation, Ltd., N.S.F., Ltd., Painton & Co., Ltd., and A.B. Metal Products, Ltd.

As in previous years, the vast range of products made by A. F. Bulgin & Co., Ltd., was on view and again many additions had been made in the various classes. The comprehensive range of "Cinch" components displayed on the stand of the Carr Fastener Co., Ltd., was supplemented by a new valveholder for printed circuits, and a plastic snap-in nut for simple and rapid assembly. Among the many items displayed by Belling & Lee, Ltd., was a new version of the general purpose fuse link in which the caps, glass and filament are bonded into one unit. Other new items included the "Airfuse" safety fuse-link for aircraft, and printed circuit connectors.

As would be expected, an important section of the exhibition was devoted to instruments and test gear. For instance, Ferranti, Ltd., had an integrated microwave test bench and hermetically sealed indicating instruments as well as valves, cathode ray tubes, resin cast transformers and chokes and T.R. cells. The f.m. signal generator shown by Marconi Instruments covers the range 19·7 to 102·5 Mc/s



Advance Components video signal generator



Marconi f.m. signal generator

and includes a precision piston attenuator which allows the open-circuit output to be set to any level between 200 mV and 0·2 μ V; the source impedance is 50 Ω. Among items shown by Advance Components, Ltd., were a pulse generator, a video signal generator, a " Q " meter, and a turret attenuator of novel design. The Automatic Coil Winder & Electrical Equipment Co., Ltd., demonstrated its new " Avo " valve characteristic meter. Other concerns represented in this section included Measuring Instruments (Pullin), Ltd., Salford Electrical Instruments, Ltd., Dawe Instruments, Ltd., British Physical Laboratories, Ltd., and Taylor Electrical Instruments, Ltd.

A number of companies showed magnetic materials, permanent magnets or alloys for special purposes, including Harrison & Catherall, Ltd., Swift Levick & Sons, Ltd., Murex, Ltd., James Neill & Co. (Sheffield), Ltd., and Henry Wiggin & Co., Ltd. Magnetic materials were also shown by Standard Telephones & Cables, Ltd., alongside " Stantalem " electrolytic capacitors employing tantalum electrodes, and a wide range of " Sentercel " selenium rectifiers including many miniature components specifically designed to the requirements of the electronic industry. The " Westalite " rectifiers for radio and television anode supplies shown by the Westinghouse Brake & Signal Co., Ltd., included both the usual spindle types and the newly developed contact cooled rectifiers for chassis mounting. The latter dissipate their losses through the chassis, thereby saving space and increasing efficiency.

Cable-Sheath Fractures

THE discussion on the paper entitled " The Installation of Metal-Sheathed Cables on Spaced Supports " which was presented by Mr. W. Holttum on 14th April before the Institution of Electrical Engineers' Utilization Section (*Electrical Review*, 15th April) was opened by Mr. D. B. Hobb (Imperial Chemical Industries). He said that in his own industry outside cables were habitually run on supports, but at nothing like the spacing recommended by the author. In one factory 48 miles of 6·6 kV and 11 kV cables and 227 miles of medium voltage cables had been installed since 1934—all lead-alloy sheathed and armoured. In another factory since the war 26 miles of cables had been installed in the open without a single case of cracked lead sheaths with compound leakage.

In 1930 a buried unarmoured plain-lead sheath cable had failed in a duct which crossed a railway line in a bridge embankment owing to vibration. When alloy-lead cables were installed there was no further trouble.

Mr. J. A. Broughall (British Railways) stated that the present policy of the railways was preferably to bury the cables but where this was not possible, to give them continuous support in a concrete trough or as a last resort to put them on hooks with continuous support which acted as a sun shield.

Mr. J. V. Peacock (McLellan & Partners) said that in industrial situations trouble seldom occurred and a precisely measured sag was not so necessary. The conditions there were less onerous because of a restricted range of ambient temperature and of working temperature since cable size might be selected more on voltage drop than on current carrying capacity. Cable runs in factories might be long but not many were straight. Changes of direction tended to provide for expansion.

Mr. C. C. Barnes (Central Electricity Authority) held that the problem was very important because recently cables up to 6·6 kV had been permitted an extra 10 deg C temperature rise (80 deg C maximum conductor temperature), which it was hoped to extend later to 11 kV cables.

Mr. W. J. Webb (British Railways) urged caution in accepting the author's view that cable supported intermittently might be an even better arrangement than continuous support. Continuous support provided on engineering grounds the best method of avoiding fracture of the supported member, and the spacing proposed was appreciably greater than that normally adopted which had been arrived at empirically after many years of practical experience.

Mr. E. A. Cullen (Eastern Electricity Board) observed that single-lead cable appeared to be more prone to fracture because of the higher internal pressures when thermally stressed. He suggested that it might be worthwhile extending the use of tape armouring. The rigidity of aluminium sheaths necessitated the use of bolted cleats, which should be avoided.

Mr. T. S. Pick (L.T.E.) said that many cables of London Transport were now reaching fifty years of life. On some 800 miles of cable on the Underground Railway there were never more than three cable failures a year. The trouble started when B.S. 480 cable was used. Unlike the older cable this cable had a very light sheath. The early cable acted as a beam with nice curves on top, whereas the B.S. 480 cable acted like a piece of string and formed a catenary with sharp bends.

Mr. H. Elder (New Zealand Railways) said that the present tendency in New Zealand was to use 11 kV and 1,500 V cables, partly owing to trouble experienced through laying cable on concrete supports and the necessity to move the cable when extra track had been laid.

Mr. G. Davidson referred to the practice of the railways of carrying cables continuously in flat concrete troughs, which unless covered for protection from sunlight, might cause more trouble than carrying them on regular supports at intervals, because with a cable laid flat any expansion would immediately cause an " S " bend which would be worse than if the cable were on regular supports.

Mr. L. Gosland (E.R.A.) said that if one took the temperature rise of the sheath and the temperature rise of the core, the cross-section area of the sheath and of the core, together with the modulus of expansion of the sheath and that of the core, and treated them as a composite system, an expansion of the cable was usually obtained which was close to the values calculated, particularly of single-core cable.

Mr. W. S. Lovely pointed out that the more the spacing was opened up, the greater would be the tendency towards sagging. Cable could be regarded as a tube. It was a large diameter strong tube or a small diameter weak tube, which would have a deflection under its own weight. Considering cabling as a pipe, a steel wire on a cable had a better chance of staying straight with wire supports than the ordinary non-armoured plain lead cable.

Mr. W. G. Hawley said that the best place to put a cable was underground. When it was down there it was at least shielded from the sun, there was distributed movement all along its length, and even if it leaked no one would see it! With the cable installed above ground it was heated either by the sun or by loading conditions and tended to lengthen longitudinally.

WORLD ELECTRICAL MARKETS

Small Scope in Ecuador

From a Quito Correspondent

IT has been estimated recently that electricity is produced in Ecuador in roughly equal parts by hydro-electric and thermo-electric plants, to an amount of 48,700 kW, an average of about 15 W per head of population. The public supply is normally a.c. at 110 V 60 c/s. Average annual consumption, on a basis of 3,700 hours per year, is put at 179 million kWh, or 58 kWh a head: in other words the Ecuadorean consumer, while using electricity for a greater proportion of the time than consumers in any other South American country, and indeed in many European countries, has one of the lowest rates of consumption in South America. The absence of reserve power in existing plants is clear.

Hydro-electric power is used fairly generally in the Sierra or highland area of Ecuador, but the usual source in the coastal area is a diesel-electric set of some 25 kW. In general it may be said that about half of the existing plants have an output of less than 50 kW, and about a quarter of less than 15 kW.

Sources of public supply are to a great extent in municipal ownership. Exceptions to this are the plants belonging to the Empresa Eléctrica del Ecuador, comprising a 13,500 kW diesel set and a 5,000 kW steam turbo-generator in Guayaquil and hydro-electric plant at Riobamba with a normal capacity of 1,150 kW. The company already has plans for the installation of another 5,000 kW plant at Guayaquil in anticipation of a further 25 per cent increase in demand by 1956.

Neither the amount of power at present available nor the supply network is sufficient for the needs of the country, and many commercial undertakings have found it desirable to install their own generators. The required operating voltage for domestic installations and appliances is rarely available even in Quito and Guayaquil, which leads in some cases to the use of transformers and boosters and a consequent waste of power and increased overloading.

It has been realized that the lack of electric power is a major obstacle to the economic development of the country, and the provision of an adequate supply now ranks with the extension of the road system as a prerequisite to progress. Plans have been drawn up on a nation-wide basis for an improved supply of more than twice the present power, which, it has been suggested, would cover the probable demands of consumers for some six or seven years: after that it is thought that a further increase will be necessary. The proposals involve the increasing use of water power, and the employment of relatively fewer generating stations of higher output.

A project of immediate interest is that for the construction of a new 14,500 kW hydro-electric plant for the Municipality of Quito, at Cununvacu. There has been discussion of the possibility of a World Bank loan to be applied to this work. A recent Press article suggests the possibility of a United Kingdom firm financing the supply network of the Alao hydro-electric plant in Riobamba and its neighbourhood. British firms tendered in 1953 for this generating plant, and for the Illuchi hydro-electric plant at Latacunga, but the contracts went to Swiss manufacturers.

There is no home production of electrical machinery and equipment, but the recently opened Empresa Cerámica Nacional, at Riobamba, is to make electrical insulators.

In general the United States supplies the greater part of Ecuadorean imports, and this also applies to electrical goods with one or two exceptions. The most recent detailed statistics for Ecuadorean imports available are those for the year 1953: these show the importation of electrical goods as in the accompanying table.

It will be seen that the main rivals to the United States were Germany, active in all fields; Belgium, for generators, motors, transformers and cable; France, for cable, switches and plugs; and Sweden. Although the United Kingdom share is at present small, there would appear to be no reason why British goods should not meet with success in the market. It must be borne in mind that price is an important factor and that the public taste has to great extent been conditioned by American styles. Credit is also of importance: the Ecuadorean customer expects to pay for anything over a period varying from 18 months to two years for expensive consumer goods, such as the larger radio receiving sets or refrigerators, to three or four years or more for large electrical machinery. It may be of interest that about $29,000 worth of radio receivers were imported from the United Kingdom in 1953.

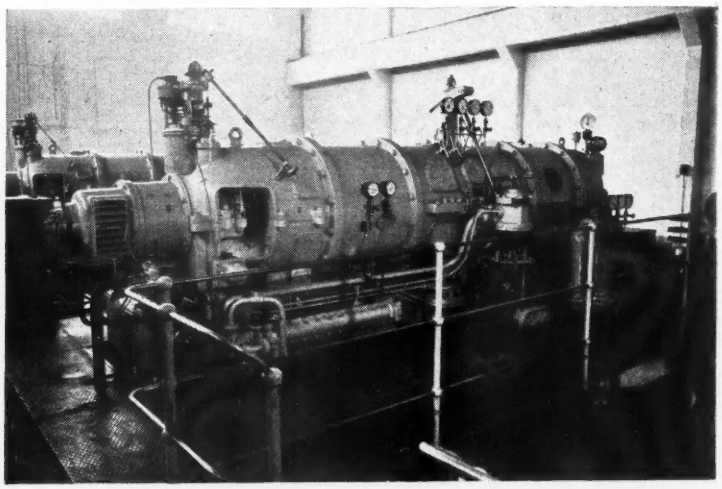
There is little doubt that success in the market requires the appointment of an agent, and the most satisfactory method of appointment is for a Spanish-speaking member of the firm concerned to visit the country, and, having studied the ground, to appoint the best agent available. The market is somewhat congested with foreign agencies and it is becoming increasingly difficult to find suitable agents for British firms. There is a sharp contrast between the highland area of Ecuador and the coastal region: in consequence it is in most cases desirable for firms to be represented in both areas. Although in a few instances this may be automatically achieved through the chosen agent's maintaining branches in both places, it involves for the most part the appointment of separate agents in Quito and Guayaquil.

ECUADOREAN ELECTRICAL IMPORTS IN 1953 (THOUSANDS OF DOLLARS)

Class	U.S.	Germany	Belgium	France	Sweden	Holland	U.K.	Total
Generators, motors and transformers	734	195	94	—	12	16	32	1,093
Batteries and accumulators	273	32	—	—	3	—	15	338
Bulbs and lighting fittings	62	14	6	—	—	19	3	124
Cable and insulated wire	48	77	28	94	17	4	4	303
Portable electrical appliances ...	27	7	—	—	1	1	2	40
Domestic appliances*	51	2	—	—	2	2	—	58
Cooking stoves, etc.	73	15	1	—	7	1	2	100
Meters	2	17	14	2	—	—	—	35
Other apparatus	9	4	—	—	62	—	2	78
Switches and plugs, etc.	17	1	3	20	—	—	—	42
Insulators	3	10	—	—	—	—	—	15
Parts and accessories	333	25	2	—	—	1	2	380
Total...	1,632	399	148	116	104	44	62	2,606

* Not including refrigerators, which are for the most part American.

Power for Indian Cement Factory



2,400 kW Brush-Ljungstrom turbo-alternators in power station

THE use of thermal generating stations as forerunners to large hydro-electric schemes is illustrated by work completed recently in India by Brush Export, Ltd. In this instance, generating equipment has been installed in a cement factory whose products will be used to build a dam for the hydro-electric scheme on the Rihand River which will, in turn, eventually provide the factory with power.

The factory has recently been erected at Churk, and is now in production. It has been built as part of a larger development programme for the Mirzapur District by the Government of the United Provinces. The major purpose of this programme is the exploitation of the valuable mineral resources of the area, and generally to relieve unemployment.

Power for the cement factory is generated in its own station, where the plant consists of three 2,400 kW Brush-Ljungstrom turbo-alternators. Because the factory will eventually take its power from the hydro-electric station the whole of the factory plant has been designed on the "unit" principle. The units, each consisting of one turbine, one boiler, h.v. and l.v. switchgear, and a station transformer for supplying the ancillary equipment, can be dismantled and installed, if required, in different power stations without substantial increase in plant requirements.

The steam conditions of the turbo-alternators are 300 lb/sq in and 700 deg F, the alternators being designed to generate at 3,300 V, 50 c/s, 0·9 p.f. The steam generating section of the plant consists of three John Thompson stoker fired water tube boilers each having a normal evaporation of 25,000 lb/hr and a maximum continuous rating of 30,000 lb/hr. The boilers are designed to burn low-grade Bengal coal having a gross calorific value of approximately 10,000 B.T.U./lb as fired and containing 18 per cent ash with 23 per cent volatiles.

Power for the station auxiliaries is obtained from three Brush 300 kVA 3,300/440 V step down transformers which feed into a seven-panel l.v. switchboard and thence to the larger motors direct, and through fuse distribution boards to the smaller motors. The main 3,300 V switchgear is a twelve-panel board consisting of switchgear with spring-operated mechanisms. The main outgoing feeders from the power station feed direct to a fourteen-panel switchboard in the mill motor house which is fitted with an air filtration and cooling plant. This switchboard controls the whole of the power used in the cement factory and the motor room. Three 1,250 kVA transformers feed a fourteen-panel, 440 V switchboard from which radiate feeders to all the various buildings in the factory. A 750 kVA transformer feeds an 11 kV line to the quarry some three miles from the factory, and there is also an overhead line to the water pumping station controlled from the motor room h.v. switchboard.

The distribution system has been so designed that should there be an electrical breakdown on any cable or portion of electrical equipment, one kiln and one half of the factory can still be kept in operation until repairs have been carried out. Similarly, the most vital sections of the plant have been so connected that there is always a duplicate supply available.

The main lighting switchboard is installed in the mill motor house and consists of three oil circuit breakers and twelve fuse switch units. It is fed from the main fourteen-panel l.v. board by duplicate feeders and in turn feeders radiate to all parts of the factory except the power station. In the power station the lighting has been arranged through duplicate supplies so that the failure of any one supply will only reduce the lighting and no part of the power station will be in darkness. As an added safeguard a system of emergency lighting has been provided. The lighting circuits in the various buildings have been wired with v.i.r. aluminium sheathed cable.

The total connected motor load in the cement factory and quarry is 8,934 h.p., consisting of two 875 h.p. and two 775 h.p. h.v. synchronous induction motors and 169 l.v. motors, the largest of which is 360 h.p.

The design, supply and installation of the complete electrical system, including the power station, was carried out by the General Engineering Division of Brush Electrical Engineering Co., Ltd., Loughborough, for Vickers-Armstrongs, Ltd., who were the main contractors for the complete cement factory. The sub-contractors included John Thompson Water Tube Boilers, Ltd. (boilers); British Insulated Callender's Construction Co., Ltd. (cables, overhead line equipment and crane down shop leads); Allen West & Co., Ltd. (l.v. motor starters); Drake & Gorham (Contractors), Ltd. (lighting fittings); Johnson & Phillips Ltd. (aluminium sheathed v.i.r. cable for lighting through Drake & Gorham); and the General Electric Co., Ltd. (sub-distribution fuseboards).

Electronic Flash in Photography

UNDER the above heading Mr. A. S. Cross, M.Sc., delivered a lecture to the Association of Supervising Electrical Engineers in London on 19th April. The lecture opened with a brief introduction on the history and development of electronic flash photography and continued with a description of some of the apparatus and techniques for still and motion picture photographs. This form of lighting has applications in many fields, particularly where a rapid movement has to be studied. Some of these applications were discussed and described.

IMPULSE GENERATORS

Problems of Operation and Design

By L. L. PRESTON, B.Sc.Tech., A.M.I.E.E.*

SINCE the general theory of impulse generators is well known, it is proposed to discuss the more practical aspects of the design which are of interest to the user and which represent the outlook of different designers. The primary consideration is to decide which of the three main kinds of load the generator is intended to test.

For insulator and low capacitance load tests representing the first kind, the simplest type of equipment will satisfy the requirements, since the capacitance of the generator need only be small. Insulators are normally designed to flash over before puncture voltage is reached and they will usually withstand an infinite number of surges causing flashover. It follows that calibration of the equipment can be carried out at the full test voltage, probably by using a spark gap, and it may not be necessary to have an oscillographic record.

The second kind of load is that involved in cable tests. Fairly high capacitance samples are often used, and if 1 microsecond wavefronts are to be obtained the circuit inductance must be kept low or overswing will occur. It is usual to test only a sample length, and if the test is in any way unsatisfactory it can be repeated on another sample. At the same time cables will not withstand unlimited flashover voltages which would be applied by spark gap calibration at full voltage, and consequently calibration has to be carried out at lower voltages, making the use of a cathode ray oscillograph desirable. However, single channel records are all that is necessary, and if a substitute load of similar characteristics is provided capable of withstanding the full voltage, calibration can be carried out at the test voltage itself. A potential divider and oscillograph are useful in any case to indicate small breakdowns which might otherwise not be apparent until a major failure occurs.

The last case, that of transformer tests, is more complex than in the two previous cases and justifies more elaborate equipment. Tests have to be carried out not on a sample but on a complete transformer and the cost of a single failure can be comparable with that of the generator itself. The waveshape is affected to a large extent by the transformer characteristics and therefore calibration must be carried out with the transformer connected in circuit, multichannel oscillographs being used to establish the test conditions and results. A large range of capacitances and voltages has to be accommodated and the potential divider and oscillograph are used to indicate breakdown as well as to measure the applied impulse.

It is also necessary to take other factors into account, but in every case the considerations can be affected by the purpose for which the equipment is required and the cost of unnecessary failure caused by faulty testing technique or apparatus.

Requirements of Generator Spark Gaps

The essential principle in the design of generator spark gaps is that the stage capacitors are charged in parallel, and discharged in series at the appropriate time by the operator. It follows that the interstage spark gaps should be set large enough to withstand the charging voltage, and yet small enough to break down in sequence when the lowest stage is discharged. Under bad atmospheric conditions these requirements can be almost impossible to meet, but fortunately in practice with standard 1/50 microsecond waves a gap spacing can be arrived at which will be high enough to withstand the charging voltage for a short time and at the same time is within the range of the overvoltage which causes sequential firing.

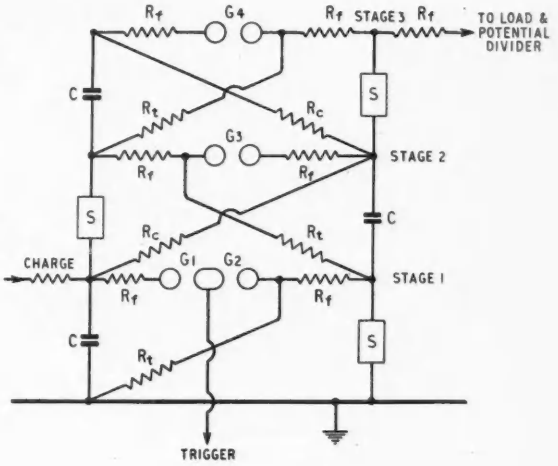
Some generators are operated by moving all the spark gaps to a maximum opening, the first stage being set to a slightly lower spacing than the remainder. The generator is then charged up and the gaps closed until sparkover occurs. This is repeated for each surge unless random sparking can be tolerated.

The most commonly used spark gap system consists of one set of fixed spheres and another set of moving ones which are swung about a vertical axis by an insulated drive. It is simple to make but difficult to adjust over a large range since the conventional method of adjustment which is to screw either the moving or fixed spheres on their supports causes different adjustments to the smallest and largest gaps. If the method of operation already described is satisfactory then a rotary gap system is all that is needed since at all charging voltages lower than the maximum, the gap separations during charging are high and setting errors are not likely to be important. At a later stage it is necessary to refer to this point again because other requirements cannot be met, and more elaborate operating systems are desirable.

All generators should be designed to produce both

Diagram of connections of impulse generator

C STAGE CONDENSER
S SPACER
R_f WAVEFRONT CONTROL RESISTORS
R_t WAVETAIL OR DISCHARGE CONTROL RESISTORS
R_c CHARGING RESISTORS



* Mr. Preston is with Ferranti, Ltd.

positive and negative outputs, and the stage sparking surfaces should be sufficiently large in diameter to have the same characteristics at the maximum charging voltage of either polarity.

In dealing with the charging voltage a compromise has to be made between the cost of the charging equipment on the one hand, and the desirability of having as few stages as possible on the other to lower the inductance, although the cost of the gap mechanism also influences the design.

Choice of Rectifier

In the main, three types of high voltage rectifier are used. Mechanical rectifiers are probably the cheapest to make and are robust. The disadvantages are that they need a certain amount of maintenance, and it is likely that there will be a significant amount of ripple on the h.v. supply. Continuous sparking which occurs may cause oscillographic trouble. If it is desirable to disconnect the charging equipment from the generator on the low voltage side when the generator is charged, a blocking condenser capable of withstanding the full charging voltage would be needed to prevent discharge through the high voltage transformer winding.

Hard valve rectifiers are a satisfactory solution to the problem as they have a high inverse resistance, no moving parts and no arcing takes place during charging. The disadvantages are that they are fragile, and need a filament transformer. Under some conditions they will limit the peak charging current which is obtainable because of inadequate filament emission.

Metal rectifiers have become available in recent years and are ideal for charging equipments. They are robust with high short-time current ratings which are necessary to recharge the generator rapidly, and if a properly designed charging resistance is used the equipment is for all practical purposes short-circuit proof.

Voltage Control and Measurement

Smooth control of the charging voltage is essential with any impulse generator since voltages are often adjusted to less than 1 per cent difference between flashover and no flashover. A fundamental requirement is to measure as accurately as is necessary the surge which has been applied to an object under test, and to determine the corresponding charging voltage of the generator so that the desired impulse voltage will be produced when discharge takes place.

A good deal has been written about high voltage potential dividers, and there are many different opinions about the best kind to use. In most cases a divider has to measure an impulse voltage and in addition to indicate whether or not breakdown has occurred. The first requirement is a relatively easy one to meet on conventional waveshapes, but the second requires the highest possible frequency response. Ordinary resistance dividers are unsatisfactory at high frequencies because of the non-linear capacitance distribution and although they have been combined with shaped electrodes they have only been made for the lower voltages. If large values of shunt capacitance are used to correct the voltage distribution then the frequency response and sensitivity of fault detection will be adversely affected.

Pure capacitance dividers are used and the main disadvantage is that it is more difficult to measure the ratio than with resistance types, and end terminations of the transient cables need more thought. Dividers of low capacitance are more likely to be affected by stray fields than those of larger capacitance, but they will in general have a better frequency response. Both long and short term calibrations are made, the latter usually by sphere gap to check the condition of the equipment and also to demonstrate to an inspector that the required voltages are being produced.

High-speed cathode ray oscillographs are used in conjunction with potential dividers and these may influence the design of the generator with which they are associated. All oscillographs require a finite time to begin to sweep after receiving a tripping impulse, and there are two main methods of overcoming this problem. Usually the circuit is designed so that the transient is delayed on its way to the deflection system, often by inserting a longer length of cable than that required for tripping purposes. An alternative is to discharge the generator after the oscillograph time sweep has been initiated. For all practical purposes impulses travel along the more commonly used recording cables at 500ft per microsecond, and a corresponding delay can therefore be obtained. Unfortunately the termination of a cable in such a way that it is independent of frequency is difficult to achieve and errors can occur unless great care is taken with the design.

The extent of the delay which is desirable is a matter of taste, but there is a strong case for having a substantial part of the sweep at zero potential before the surge indication is received. This calls attention to any error which might occur if the separately applied zero line is displaced from the surge voltage zero and reduces the effect of non-linearity which sometimes exists at the start of the trace. Time delays of this order will depend on the sweep time and may be considerable in some cases.

If such a system is used it is obviously an advantage to keep the delay constant with generator output voltage, and although it is possible under extremely good conditions on a small scale to vary the time lag of a spark gap by controlling the overvoltage applied, it would then be additionally essential to have a high degree of trigger gap accuracy with charging voltage. For the worst conditions the ideal method of obtaining delay is to apply a large pulse after the required time has elapsed, to the triggering electrode sufficient to cause flashover after a very short time. It is not possible to reach this ideal at high voltages but an approximation can give satisfactory results, and even with exponential time bases it is sometimes possible to superimpose voltage records with considerable accuracy.

In all cases of controlled firing of the generator the method of operation referred to earlier cannot be used, and the gaps must be set for the actual charging voltage. Accuracy of spark gap setting at any charging voltage is desirable and becomes more difficult as the operating range is increased, since accuracy is usually determined by the smallest spacing used. It is this consideration which justifies a more elaborate spark gap mechanism.

Returning to the other voltage measurement problem, it is essential to measure sufficiently accurately the charging voltage before discharge takes place. The use of primary a.c. voltmeters is unsatisfactory since they are subject to waveform regulation and ratio errors. One satisfactory method is to use a high-stability, high-resistance potential divider at the output of the main charging resistance, and an associated moving coil instrument to indicate the actual potential to which the generator is charged. This resistance must withstand surges itself, and since calibration often takes place at 50 per cent, or less, of the maximum testing voltage, the actual voltmeter readings are multiplied up at each stage to obtain the next impulse voltage level when the generator is discharged. For all normal operation the charging voltage is free from ripple when discharge takes place and the mean voltage indicated by the voltmeter will be an accurate measure of the charging voltage.

In addition to the normal advantage of increasing the capacitance of the generator at the lower voltages, parallel-

ing also increases the operating range, since with fewer stages in series the corresponding charging voltage for a given output can be higher than the value needed when all stages are connected in series. A good design of spark gap mechanism will allow operation at the lower charging voltages normally and make it unnecessary to parallel for this purpose alone.

For the commonly accepted use of the word, paralleling has undoubted advantages and designers have given considerable thought to the problem. One ingenious solution makes a switch arrangement for this purpose the centre feature of the design. A lever controls insulated switches operated by a set of cams or their equivalent and parallels down to as low as one stage. Other designers put a higher priority on low circuit inductance and the ability to operate with a considerable proportion of the front or series resistance after the tail resistance.

With 1 microsecond (completely damped) wavefronts, inductance of the generator and circuit will limit the capacitance load on which the generator will operate, while the position of the front resistance in the circuit affects the voltage efficiency at low loads or even at higher ones if slower fronts are used. A number of generators have a permanent minimum capacitance load to avoid the difficulty of low load efficiency but under some conditions recording sensitivity can be affected in the process.

It is essential that the series or front resistances should have the lowest possible inductance to enable the generator to work on a wide range of load capacitances, and the discharge or tail resistances non-inductive. It is usual for both front and tail resistances to be wire wound so that their values will not change during a surge and reliable operation can be obtained. Charging resistances are usually many times the value of the tail resistances in ohms and provided their impedance does not rise unduly at resonance they need not be non-inductive.

The voltage distribution set up during flashover of a load can defy the imagination and for earthing all that can be done is to consider one point of the circuit (usually the generator base itself) at earth potential and make provision for a rise in potential at other points. It is often necessary to spend considerable effort to avoid trouble in cathode ray oscillographs when flashover takes place and high sensitivity instruments of the radar type are at a disadvantage.

So many things can, and often do, go wrong with an impulse testing equipment that nothing short of great care in design, manufacture, maintenance, and operation will suffice if satisfactory tests are to be carried out as a matter of routine. In particular, atmospheric conditions can cause a premature flashover of the generator, and leakage can be a problem. Oscillographs also are subject to the usual failings of electronic gear, and a good deal can yet be done to improve them.

Concept of Ferromagnetism

THE third annual celebrity lecture of the Permanent Magnet Association was delivered in Sheffield on 14th April by Professor L. F. Bates, Ph.D., D.Sc., F.R.S.

The lecturer dealt with the development of the domain concept of ferromagnetism, initially postulated by Pierre Weiss to explain the fact that one might take a piece of unmagnetized iron and yet by the application of a weak magnetic field one might easily magnetize it strongly. The iron was supposed to consist of a collection of small regions or domains each strongly magnetized, but the directions of magnetization of the several domains were so randomly orientated when the iron was in the unmagnetized state that they neutralized one another, while in the strongly magnetized state their directions of magnetization were practically parallel to one another. In recent years the domain concept has been greatly developed to account for some of the magnetic properties of single crystals of the ferromagnetic metals, of polycrystalline rolled silicon-iron and, finally, of permanent magnet materials like Alcomax.

The most spectacular way of showing the existence of domains was the powder pattern method, a modern extension of the well-known method of plotting the field around a bar magnet by means of iron filings. On a highly polished and carefully annealed surface of a ferromagnetic crystal a drop of a solution of colloidal magnetite was placed (or a very fine ferromagnetic powder was blown) when the magnetic particles collected above those regions of the surface where a boundary between two neighbouring domains intersected it. This deposition occurred because such boundaries separated domains whose directions of magnetization differed; e.g., in the case of iron the angle between two such directions was usually 90 deg or 180 deg, and so one talked of 90 deg and 180 deg boundaries. Because the direction of magnetization within a boundary changes continuously in passing from one side of the boundary to the other, a stray field existed wherever a boundary cut a surface. The powder pattern technique allowed us to prove that we might picture a single crystal of a ferromagnetic metal as made up of the main domains just described, together with a number of small, subsidiary or closure domains whose function was to avoid unnecessary surface magnetization of the material.

It was extremely interesting to see a film which illustrated the experimental technique and to watch the formation of domain patterns in a changing magnetic field, especially upon the surface of a crystal of cobalt, as in this material the domain structure was very pronounced as well as being the simplest known. It was also striking to view photographs which showed how the motion of domain walls was impeded by the presence of impurities or defects in a material and to discuss the importance of these phenomena in regard to the performance of transformer materials.

Oxide-Cathode Valves

MAINTENANCE of satisfactory long-term emission from an oxide-cathode valve was considered broadly in an interim paper presented on 20th April by Dr. G. H. Metson (Post Office) before the Radio Section of the Institution of Electrical Engineers. The approach was experimental and based on the assumption that emission would be maintained so long as sufficient metallic barium remained in its oxide matrix. A tentative conclusion was reached that a cathode working under a current load in gas-free surroundings would continue to emit until the matrix was exhausted by electrolysis and evaporation. The paper was divided into two parts, the first dealing with a chemically inert platinum core and the second with passive and active nickel cores.

Argentine Programme Accelerated

From a Correspondent

AN increase of 20 per cent in expenditure under the second five-year plan (1953-57) has recently been authorized by the Argentine Government. This includes a further sum of up to 9,000 million pesos for the fuel and electric power programme and 3,820 million for communications, especially the telephone service. Part of these additional resources will be drawn from the National Energy Fund and from the Telephone Department, respectively.

Priority is to be given to power house development under the general plan for increasing imports of industrial equipment, which is urgently needed owing to the drastic exchange restrictions of the past two years. The Central Bank will also consider individual applications submitted by power users. The Finance Minister said he hoped by this means to solve one of the most important problems affecting many provincial towns as well as national industries.

Production of electric power has not kept pace with the demand created by industrial expansion and population growth. The public service, which contributes practically the entire installed capacity, had an output of 3,911 million kWh in 1948 for a population of 16·1 million, equivalent to a consumption of 243 kWh per head. By 1953 production had increased to 4,927 million kWh, representing a *per capita* consumption of 271 kWh.

In January last the Minister of Industry invited representatives of selected foreign manufacturers to a conference at which the Government's plans for increasing the supply of electric power to greater Buenos Aires were explained. The meeting was intended to ensure an adequate response to the forthcoming call for tenders. Acceptance of these depends largely on exchange availabilities and the credit terms offered. Argentina's needs greatly exceed her capacity to import and purchases abroad of capital equipment now go to those countries which offer the most generous credit terms.

The thermal power station at San Nicolas and the transmission lines from there to Rosario and Buenos Aires are scheduled for completion in July, 1956. Four alternators, with a combined capacity of 300,000 kW, are estimated to produce 1,200 million kWh annually, a 25 per cent increase on Argentina's total output in 1953. The rate of increase has averaged 27·8 per cent over the past five years, the supply having expanded from 4,120·6 million kWh in 1949 to 5,269 million (estimated) in 1954. Of the total, Buenos Aires City absorbs some 2,700 million and the remainder of the province, 1,500 million. The cost of the plant, including transmission system and storage accommodation for 190,000 tons of coal and 30,000 cu m of oil, is estimated at 1,200 million pesos. It is intended eventually to substitute natural gas from the Argentine oilfields for coal, so as to avoid an increase in imports of coal, which amounted to 1,443,308 tons last year. Other power plants are to be built at Mar del Plata, Chivilcoy, Chascomus and Dolores.

During the first year of operation of the Argentine Foreign Capital Investment Law (August, 1953) over 100 investment proposals were received and the number of requests for information exceeded 500. Of the total, seven, representing an aggregate investment of 162 million pesos, were accepted in the first twelve months and 27 others, involving 175 million, were under consideration. The new law establishes absolute equality between national capital and foreign capital entering after that date, exemption of customs duties on machinery and equipment for the new installations and facilities for transferring profits and repatriating capital.

One of the complaints voiced at the time was that foreign capital invested in Argentina before August, 1953, did not enjoy the same facilities. This complaint has since been met by a decree of 17th January last which makes concessions to holders of such capital invested in mining and industrial enterprises.

Electrical Imports

Comparative figures for 1953 and 1954 show that the value of British exports of electrical machinery, apparatus and appliances to Argentina increased last year by £38,246 to £1,022,210. The Central Bank announced in March that exchange permits to a total value of 30·5 million pesos would be distributed for imports of electrical cables and wires; materials for electricity supply, radio and telephony; meters; and other specified merchandise.

A new trade agreement between Argentina and the Belgo-Lux Union, which remains in force for two years from 15th February last, provides for commercial interchanges to the value of 45 million convention dollars in each direction. The Benelux Governments will grant payment facilities for Argentine purchases of capital goods for developments under the second five-year plan. Argentine imports will include power house equipment and materials for transport systems, ports and communications.

Negotiations are now proceeding to modify the 1952 treaty with Italy, which was originally intended to regulate trade and financial relations between the two countries until the end of 1958. It provided for normal commercial exchanges to the value of 110 million dollars annually, plus the supply by Italy of capital goods to a total value of 75 million on five-year credit terms. Imports of capital equipment, which include power house equipment, have already exceeded the scheduled credit and Argentina hopes to obtain additional and more ample facilities. In return, Italy demands supplies of certain much-needed Argentine produce at international prices and freer access to the Argentine market for Italian manufactures, including non-essentials.

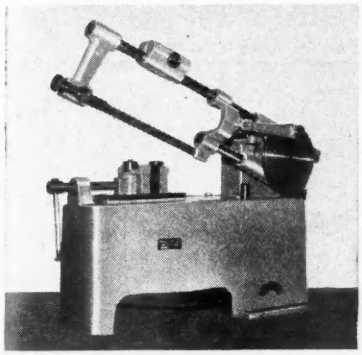
British Association Meeting

THE provisional programme of this year's annual meeting of the British Association for the Advancement of Science has now been issued. The meeting is to be held in Bristol from 31st August to 7th September under the presidency of Professor Sir Robert Robinson, O.M., F.R.S., whose address will be on "Science and the Scientist." The reception centre will be in the Victoria Rooms, Queen's Road, Bristol, which is adjacent to the University and the other institutions in which the meetings of the Sections will be held. The Victoria Rooms will be used for the transaction of business and as a rendezvous, and facilities will include a cafeteria, lounges and writing-rooms. A programme of excursions arranged by the Bristol Local Executive Committee includes visits to places of archæological, historical and industrial interest.

NEW ELECTRICAL EQUIPMENT

Power Saw

The power saw made by the COLNE TOOL COMPANY, Granville Works, Colchester, Essex, is small and compact, occupying a space of only 24in by 9in, and is capable of continuous and arduous service. It is designed to cut metal up to 3¾in square at any angle up to 45 deg either way, the rate of cutting being 80 strokes per minute. It can be carried by one man and put to work on an ordinary table or bench and will remain steady while cutting without bolting down. The vice can be moved along the bed of the machine so that the whole length of the blade can be used to obvious economic advantage. The motor and worm drive gear are completely enclosed, the standard motor being rated at ¼ h.p. single- or three-phase



Colne power saw

a.c. to suit all normal mains voltages but d.c. motors can be supplied if necessary.

Hard Soldering Aluminium

The SHEFFIELD SMELTING CO., Royds Mill Street, Sheffield, 4, has introduced two soldering processes for joining aluminium and its alloys to each other or to copper, nickel and steel. They have been approved by the Ministry of Supply after extensive tests at the R.A.E., Farnborough, of the corrosion resistance of various soldered joints. The first, "Thesscal A," has a melting range of 420-450 deg C, and the second, "Thesscal P.12," a range of 440 to 510 deg C. The technique of application involves heating with a simple hand torch and the use of special fluxes. One important use is for unstressed or lightly stressed parts in aircraft, when the low operating temperature enables thin sheet and sections of Duralumin to be joined by unskilled labour.

Immersion Heater

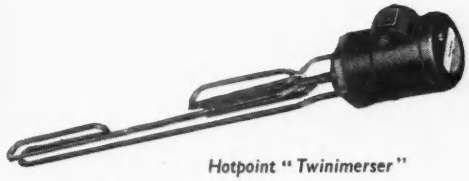
The HOTPOINT ELECTRIC APPLIANCE CO., LTD., Fletton, Peterborough, has added to its range of immersion heaters for domestic tanks the "Twinimerser," which consists of two immersion heater elements mounted on one head so as to be interchangeable with standard vertical immersion heaters and circulators.

One element is loaded at 2 kW and heats only a 10in depth of water whilst the other element is loaded at 3 kW and heats a greater depth of water from 21 to 36in. The two elements cannot however be in circuit at the same time. Both heating elements are controlled automatically at the required temperature by means of a standard adjustable thermostat and are brought into use by a built-in changeover switch. The heater head is designed for fixing to a tank or cylinder by the normal one hole sweating ring or mechanical flange screwed for 2¼in BSPT.

The switch to change over the heaters from "sink" to "bath" is mounted on the head, obviating the necessity and cost of a separate changeover switch and its attendant wiring. The switch also operates a link mechanism resetting the thermostat automatically (above its differential) to enable it to take over the control of the "bath" heater element when the switch is moved to the "bath" position. A spring loaded simple friction drive enables the thermostat to be set without trouble to any temperature or altered at any time to suit the household needs.

The "Twinimerser" is for a.c. circuits 200/220 V or 230/250 V and costs £5 15s 0d plus purchase tax of £2 2s 0d in this country. The thermostat costs £1 8s 0d.

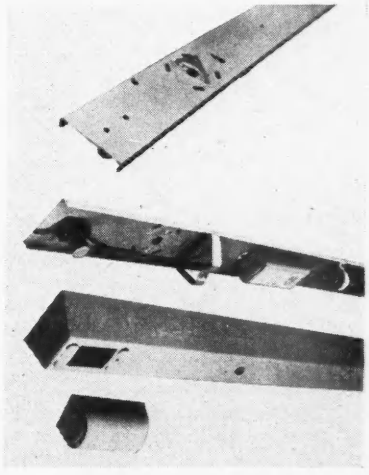
Duralumin to aluminium joint with "Thesscal A" after hammering. The sheet is 1/16 in thick



Hotpoint "Twinimerser"

Fluorescent Batten Fitting

A 5ft 80 W single batten lighting fitting, known as the "Triumph," has been introduced by SCEMCO, LTD., 6, Soho Street, London, W.1. The photograph gives an exploded view showing at the top the backplate with the new type hook for suspension



Exploded view of "Triumph" batten fitting

which falls flat into its own recess, and in the centre the accessibility of the concealed canister starter lamp.

Radio Listening Aid for the Deaf

When using the conventional hearing aid, the listener receives the output of a radio set, television set or radiogram secondhand, because the aid picks up the set-speaker's output and reproduces it again. A new instrument devised by ELECTRIC ADES, Orchard House, Sunbury-on-Thames, plugs into the output circuit of the radio or

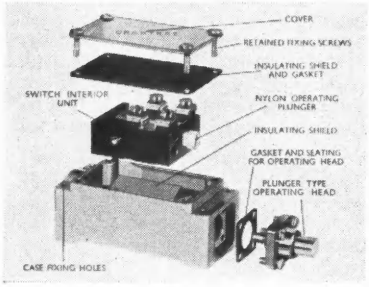
"Rai-Tel-Ade" equipment for assisting the deaf in listening to radio or television programmes

television set. Called the "Rai-Tel-Ade," it utilizes neither valves nor batteries and has the same type of miniature insert ear-piece as is used in the conventional hearing aid. The

instrument has an attractive silver grey finish and the retail price, complete with plug, socket and leads is £4 15s.

Limit Switch

A new limit switch for use up to 2 A at 600 V a.c., introduced by J. A. CRABTREE & CO., LTD., Walsall, Staffs, has a double make and a double break,



Crabtree limit switch

four clamp type terminals, and a transparent insulating shield protecting the moving parts from dust. Slow action and snap action types are available and a variety of operating heads for push-rod, roller, right angle plunger and arm and roller initiation.

Flame-and-Waterproof Distribution Box

The GENERAL ELECTRIC CO., LTD., Magnet House, Kingsway, W.C.2, has designed a flame-and-waterproof terminal distribution box for employment where complex connections and apparatus are used in wiring installations involving control and indicating circuits, or for power circuits where higher voltages or currents may be involved.

The box is cast in aluminium alloy with two side walls 1in thick, through which are drilled and tapped the necessary apertures to accept conduit, flameproof glands or cable sealing boxes. At one end of the box casting is a flat machined surface with a rectangular aperture blanked off by a cover plate secured by four steel screws. By the removal of this cover-plate it is possible for similar boxes to be rigidly bolted together to form a composite unit. The box incorporates a solid aluminium alloy casting machined overall for mounting terminals of the required size and number. The terminals, of plated brass studding, are suitably bushed and secured in position with lock nuts. The standard arrangement caters for a maximum of 52 terminals and a rating of 250 V between terminals at 7½ A.

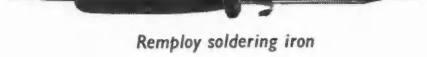
To exclude the ingress of moisture as far as possible at the joint between the box, terminal base and cover, a continuous Neoprene gasket is tightly sprung around the perimeter of the terminal base. Being slightly deeper than the terminal base, it forms a seal against the overlap of the box and cover, thus preventing the direct ingress of water and minimizing the condensation effect due to breathing.

Electric Soldering Iron

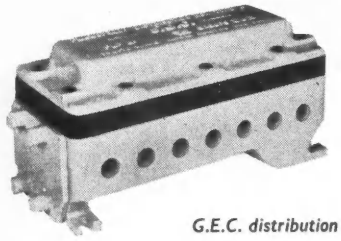
A feather-weight electric soldering iron ideally suited for small assembly, model and instrument work has just come on the market. Manufactured by REMPLOY, LTD., 25/28 Buckingham Gate, London, S.W.1, the iron is fitted with a robust neon indicator light, which is sunk into the black Bakelite handle, so that no longer is it necessary to check the plug point or test the heat of the soldering bit to see whether the iron is in circuit or not. Consumption is only 25 W and the small soldering tip and narrow stem enable it to be used in confined space: the copper bit is readily removable. The heating element is of the flat wound mica type completely encased with a metal sheath, the leads being threaded with ceramic beads. The retail price is 19s 3d.

Motor Cycle Battery

CHLORIDE BATTERIES, LTD., of Clifton Junction, Swinton, Manchester, has just introduced the 3-ER7L, a 13 Ah Silver Exide battery incorporating three technical developments. The first is the use of Porvic—a microporous plastic material—for the separators. Virtually everlasting in service, Porvic has made possible the development of a seven-plate motor cycle battery occupying no more space than the five-plate type it supersedes and offering a better electrical performance. The second important feature is the use of plate grids moulded in the new corrosion-resistant CB95 alloy and pasted with improved active materials. The new battery is assembled in a container of tough, leak proof and shock resistant hard rubber that will outlast the full life of the plates and separators. Other important refinements are included and the batteries are available for most makes and types of motor cycle.



Remploy soldering iron



G.E.C. distribution box

Silver Exide motor cycle battery

NORWAY'S ELECTRICAL TRADE

Last year Norway's electrical import trade showed a modest increase in value on 1953. The total was Kr.295 million, compared with Kr.274 million. The chief items, with notes of increases or decreases, are shown in the accompanying table. Noteworthy among the lines which advanced were electric motors, radio goods, a range of installation material, and vacuum cleaners. On the other hand there were declines in generators, convertors, accumulators and small cable. Chief suppliers were West Germany with Kr.96,500,000 (Kr.95 million in 1953), United Kingdom Kr.65,500,000 (Kr.60 million) and Sweden Kr.46,625,000 (Kr.41 million).

IMPORTS

Class of Equipment	1954 Kr. (000)	Inc. or dec on 1953 Kr. (000)
Electric motors and parts ...	57,732	+ 5,732
Generators and parts ...	25,756	− 1,744
Transformers and parts ...	11,986	− 14
Convertors, etc.	6,903	− 4,097
Galvanic cells up to 180 gr. ...	5,386	+ 305
Accumulators and parts ...	3,070	− 1,049
Incandescent lamps	11,113	+2,113
Lead covered cable up to 40 mm diam.	5,873	− 887
Ditto, 40 to 80 mm diam. ...	4,366	+ 100
Ditto, over 80 mm	82	− 15
Other electrical wire ...	7,801	+ 1,490
Vacuum cleaners with built-in motors	7,474	+ 2,014
Vacuum cleaner parts ...	2,047	+ 577
Porcelain insulators, h.v. ...	2,597	− 93
Ditto, l.v.	2,862	+ 542
Large switches and parts ...	19,115	+ 3,058
Radio valves	3,003	+ 603
Amplifiers	796	+ 296
Parts for radio receiving sets n.e.s.	2,058	+ 618
Ultra short wave transmitters for telephony and parts ...	3,812	+ 1,252
Apparatus and parts for wireless telegraphy and broadcasting, n.e.s.	11,138	+ 3,138
Automatic switchboards and parts	3,343	− 857
Automatic telephone apparatus and parts	1,439	− 431
Telephone apparatus and parts, n.e.s.	2,940	+ 20
Electric flat irons	3,186	+ 1,306
Electric meters	7,276	+ 746
Voltmeters, ammeters, etc.	1,997	+ 320
Other elec. measuring instruments and parts	2,726	+ 826
X-ray apparatus and parts ...	2,238	+ 8
Switches for house installations	1,499	+ 769
Lampholders, fuses, etc. ...	9,428	+ 3,188

Norway carries on a small export trade in certain electrical goods, the total value of which last year was Kr.21 million, half as much again as in 1953. The largest item was apparatus and parts for wireless telegraphy and broadcasting, valued at Kr.2,300,000, followed by radio receiving sets Kr.1,267,000, transformers and cable. One-third of the exports went to Sweden. (Kr.19-20 = £1.)

GENERATION AND DEVELOPMENT

Part of the Blackpool illuminations arranged in honour of the recent visit of the Queen and the Duke of Edinburgh

High Output in March

The increase in electricity generated in March of 17·2 per cent was the highest recorded for four years. In the first quarter of the year 23,082 million kWh was generated, compared with 20,382 million kWh in the corresponding period of 1954, an increase of 13·2 per cent. At the end of March the installed capacity in stations of the former British Electricity Authority (now Central Electricity Authority and the South of Scotland Electricity Board) and the North of Scotland Hydro-Electric Board was 20,819 MW. This represents an addition during the month of 212 MW.

The following new plant was installed:—Brunswick Wharf: 60 MW Metropolitan-Vickers set. Battersea "B": 425,000 lb/hr Babcock & Wilcox boiler. Drakelow "A": 60 MW English Electric set and 515,000 lb/hr International Combustion boiler. Doncaster "B": 180,000 lb/hr Mitchell boiler. Ince: 60 MW G.E.C. set. Clyde's Mill: 30 MW English Electric set. Additional diesel plant was installed at Basingstoke (1·05 MW, Ruston & Hornsby) and Macclesfield (2 MW, Mirrlees Bickerton & Day).

Skelton Grange Power Station

The Central Electricity Authority has received the consent of the Minister of Fuel and Power to establish a new power station at Skelton Grange, Leeds. The present Skelton Grange "A" power station, which will have a total installed capacity of 360,000 kW is approaching completion, five of its six 60,000 kW generating sets having been installed. The new station, to be known as Skelton Grange "B," will be adjacent to the "A" station, and will also house six 60,000 kW sets, each served by a boiler capable of evaporating 550,000 lb/hr.

Aircraft Strikes Overhead Line

Most of the Eastern Electricity Board's Suffolk Sub-Area, excluding Ipswich and Felixstowe, was without electricity for upwards of an hour last week when the wing tip of an American aircraft struck the 132 kV grid line near Ipswich. The aircraft continued on its way and made a safe landing at the U.S.A.A.F. aerodrome.

Grit from Bankside "A"

Grit emissions from the old Bankside power station were the subject of a debate in the House of Commons before the recess. Mr. George Isaacs said it was understood that when the new station went up the old one would disappear, but it still remained. Although the grit deposit in 1954 was only a little more than half what it was in 1950, it was still too much. People in the area had grit in their eyes and grit in their food.

Mr. W. F. Deedes, Parliamentary Secretary, Ministry of Housing and Local Government, who replied for the Government, said that the old "A" station was completely out of date and nearing the end of its life. It was expected that in five or seven years, if it was not dismantled, it would be used only for emergencies. But there was still the difficulty that it provided electricity which was indispensable to meet peak loads during the day time. The equipment was admittedly inadequate; of the 18 boilers only two had grit arresters. The C.E.A. was reluctant to carry out expensive re-equipment of a plant with a very limited life.

Blackpool's Royal Illuminations

To honour the visit of the Queen and the Duke of Edinburgh to Blackpool for a royal performance at the Opera House on 13th April, Blackpool staged a special decorative lighting display. It incorporated royal motifs, and only two colours, purple and gold, were used in the presentation. The scheme extended over about a quarter of a mile of the royal route from King's Square to the entrance to the Opera House.

A total of about 12,500 lamps were used in the display with a maximum loading of 150 kW and approximately 1½ miles of festoon strip were erected and 1½ miles of feeder cables. Supply was taken at low voltage from the North Western Electricity Board at four distribution points. Mr. Harry Carpenter and his staff of the Electrical Services Department of the Blackpool Corporation were responsible for the design and production of this scheme and all constructional work was carried out in the Corporation's workshops.

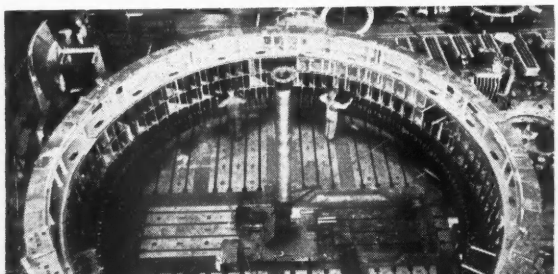
Hydro-Electric Scheme in Harris

A scheme prepared by the North of Scotland Hydro-Electric Board to supply 2,400,000 kWh annually to its distribution system in Harris has been confirmed by Mr. James Stuart, Secretary of State for Scotland. Under the scheme the waters of Loch Chliostair, which lies in the hills about 12 miles from Tarbert, will be harnessed. A

ELECTRICITY GENERATED AND PLANT INSTALLED*

	Fuel consumed Thousand tons			kWh generated Millions			kWh sent out Millions	Installed capacity (m.c.r.) MW
	Coal	Coke and Breeze	Oil	Steam	Water power	Total†		
British Electricity Authority ...	4,018	124	22·7	7,608	26	7,645	7,194	20,184
N. of Scotland H.E.B.	33	1	1·5	46	98	150	148	635
Total for March, 1955	4,051	125	24·2	7,654	124	7,795	7,342	20,819
Corres. total for March, 1954 ...	3,535	111	13·4	6,508	129	6,650	6,261	19,232
Inc. or dec. per cent	+14·6	+12·6	+80·6	+17·6	−3·9	+17·2	+17·3	+8·3
Total to date (3 months) 1955 ...	12,160	347	74·4	22,599	434	23,082	21,752	—
Total for corres. 3 months of 1954	10,956	321	47·9	19,918	422	20,382	19,203	—
Inc. or dec. per cent	+11·0	+8·1	+55·3	+13·5	+2·8	+13·2	+13·3	—

* Comprising all generating stations controlled by the British Electricity Authority and the North of Scotland Hydro-Electric Board.
† Including 12 million kWh generated by oil engines and 5 million kWh by waste heat plants in March, 1955.



Partly cored stator of 66,667 kVA, 150 r.p.m. vertical water-wheel alternator for the Eildon power station of the State Electricity Commission of Victoria, Australia. This is the first of two such alternators being manufactured by the British Thomson-Houston Co., Ltd., at Rugby, for this station. Because of the size of these machines the stators are split into sections for shipment

dam will be built across the River Eaval at the outlet of the Loch and water led by pipeline to a generating station with a capacity of 700 W situated on the bank of the River Eaval into which the turbine will discharge. The scheme is estimated to cost £270,000. The fisheries committee took no exception to the Board's proposals but on its suggestion the Board has agreed to experiment with electrical screening to prevent fish having access to the River Eaval, if this is necessary.

Maintenance Work

Carlisle City Council has informed the local branch of the Electrical Contractors' Association that further consideration is to be given to the question of contracting for electrical maintenance work on housing estates. Some time ago, the Council decided to arrange for the North Western Electricity Board to do all maintenance work, and this action brought a protest from the E.C.A.

Electrification in North East

At the quarterly meeting of the North Eastern Electricity Consultative Council at Newcastle-upon-Tyne, it was reported that since the previous meeting the Board had approved development schemes costing £1,068,611. A total of 276 substations, most of them concerned with supplies to villages and farms, had been brought into operation. In the three months under review, 392 agricultural premises had been connected and negotiations had been concluded for supplying another 304 premises. Eighteen villages were supplied with electricity for the first time during the three months.

Belgian Railway Electrification

The Belgian Government has approved plans for the electrification of the railway line between Antwerp and the Dutch frontier station of Rosendaal, the junction with the electrified lines of the Netherlands. Holland and Belgium are to share the construction of 12 electric railcars for an accelerated service between Brussels, Antwerp, Rotterdam and Amsterdam. It has also been decided to electrify the track between Moustier and Charleroi-South to complete the electrification of the Namur-Charleroi line. Work at present in progress on the electrification of the Louvain-Liège and Brussels-Arlon lines is expected to be completed this year and next, respectively.

Exhaustive tests are to be conducted during the coming months to enable a final decision to be reached on the extent to which diesel and electric power are to be used on the Belgian railways. No new orders for locomotives will be placed until the relative suitability to local conditions of the two methods of traction has been fully assessed.

Canadian Atomic Power Station

Canada's first commercial atomic power will be serving Ontario householders and industries late in 1958. Mr. C. D. Howe, Minister of Trade and Commerce, recently confirmed that the Ontario Hydro-Electric Power Commission would join the Canadian General Electric Co. and Atomic Energy of Canada, Ltd., in the construction and operation of a $15 million experimental nuclear power station. The station, which will probably be situated on the Ottawa River close to Chalk River, will have a capacity of 20,000 kW. An immediate start is to be made on detailed design.

Mr. Howe emphasized that the station would not produce power competitive with hydro stations or even with present thermal stations but would provide operating and cost experience needed for larger power reactors.

Swedish Power Output

Sweden's output of electric power last year totalled 23,700 million kWh, an increase by 1,300 million kWh (6 per cent) compared with 1953. The greatest increase was in industrial use.

STREET LIGHTING NOTES

ABRAM (Lancs) U.D.C. plans to provide class "A" lighting along Warrington Road subject to the approval of the Ministry of Transport.

BARROW-IN-FURNESS Corporation is to make application for sanction to borrow £9,925 for converting the street lighting from gas to electricity.

BILLINGHAM (Co. Durham) U.D.C. surveyor has prepared proposals for lighting trunk road A.19.

BLYTH Town Council is to begin work on the third stage of its street lighting scheme. It is proposed to erect 80 sodium lamps at a cost of over £8,600.

The conversion of all the remaining street gas lamps in CHESTERFIELD to electricity is to be undertaken in the current financial year, and it is hoped that by the end of the year three-quarters of the work will have been completed. The estimated cost is £2,976.

COVENTRY General Works Committee has approved a scheme of street lighting for Ironmonger Row and Trinity Street at an estimated cost of £1,063.

JARROW (Co. Durham) Town Council is to provide 65 street lamps in the South Perth Avenue area at a cost of £2,987.

MITCHAM Corporation is recommended to approve the carrying out of the first instalment of the district roads street lighting improvements scheme together with the relighting of the whole of the roads on the north-west side of High Street, Colliers Wood, and roads south of the West Croydon/Wimbledon railway. The estimated cost is £24,500.

PETERBOROUGH R.D.C. is to erect 40 additional street lamps in various villages during 1955-56.

RICHMOND (Yorks) Town Council has included in its annual estimates £10,136 for a proposed lighting scheme in King Street, the Cutpurse Lane housing estate and Gallowgate.

South Kesteven R.D.C. proposes to install 37 lamps to replace the present gas street lamps at MARKET DEEPING.

STAMFORD (Lincs.) Town Council is to provide electric street lighting from Red Lion Square to Uffington Road at an estimated cost of £3,540. Three other schemes to convert street lighting from gas to electricity, costing respectively £1,636, £1,953 and £474, have been approved.

Sodium street lamps are to be installed in the main street by THURMASTON (Leics.) Parish Council.

TORRINGTON Town Council, Devon, has approved a proposal by the Lighting Committee that the borough surveyor should prepare a scheme for street lighting by electricity. At present gas is used.

WIDNES Council proposes to spend £6,600 on street lighting improvements in 1955-56.

Noteworthy Staff Suggestions

IMPROVING EFFICIENCY IN THE SUPPLY INDUSTRY

THE National Joint Advisory Council for the Electricity Supply Industry has recently sent us a copy of the first issue of its "Suggestions Review," which gives details and drawings of new or modified equipment and operating methods put forward under the employees' suggestion scheme. Suitable suggestions are examined locally and an award made of an appropriate amount up to £25. The suggestion then goes to national assessors and, if deemed suitable for use on a national scale, it is the subject of a further award. The number of suggestions put forward has risen each year and the quality of those examined for national application has shown a marked improvement lately.

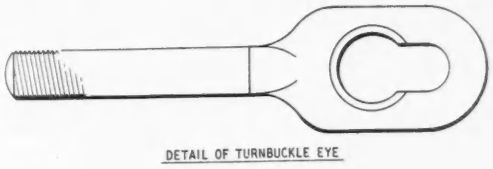
The diversity of subjects covered can be seen by reference to some of those dealt with in this review: the working of 4-ton Canadian Ford trucks, conductor tensioning tools, a safety belt buckle, fire precautions in oxy-acetylene welding, the prevention of spontaneous combustion in stacked coal, the simplification of meter wiring and changing motors on washing machines.

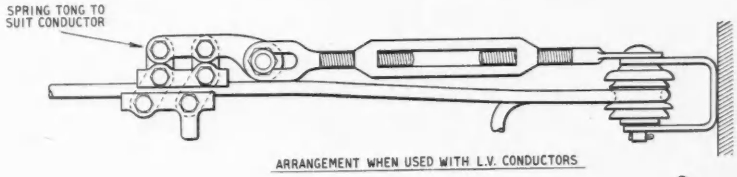
One of the suggestions refers to a conductor tensioning tool. Where low voltage networks are erected to B.E.S./L.1, it is an established and necessary practice to have all conductors held at one and the same time on tensioning devices in order that sags can be adjusted throughout before make-offs are completed. In the case of a termination on a 3-phase 4-wire network, this requires four suitable tools, and where a straight line section pole is being installed, in order to balance the pole correctly, either eight tools are required or temporary back stays have to be installed against the conductors from one direction in order to reduce the number of tools to four. In order to carry out this work adequately and economically the following tool and technique have been developed. The tool is essentially a $\frac{5}{8}$in turnbuckle with eye drawn out, drilled and slotted. The length of a "D" shackle pin, width of "D" shackle and width of insulator are such as to permit the hole in the eye being passed over the head of the pin and a sharp pull locates the pin in the slot, the tool being firmly held in a horizontal plane. The chamfering of the hole assists the entry of the slot under the head of the pin. A spring tong of approved make, suited to the size of conductor, is bolted solidly to the forward turnbuckle eye.

In use, the first conductor is pulled up to approximately correct sag by means of the "Rotolift" or "Pul-lift" and the conductor tail transferred to the spring tong on the turnbuckle. The "Pul-lift" is then transferred to the second conductor which in turn is caught off on a second turnbuckle and so on. When all conductors are on turnbuckles, a turn or two either way permits a nicety of adjustment with ease; the $\frac{5}{8}$in × $\frac{11}{16}$in ring spanner with which all linesmen are equipped makes an excellent toggle bar, the cranked head of the ring fitting securely between the arms of the turnbuckle.

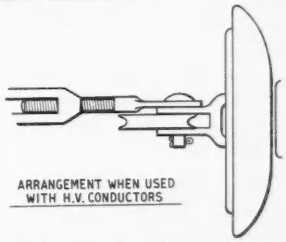
Having adjusted all conductors to correct sag, the make-off is made. This operation is carried out with much greater accuracy than by present methods, due to the shortness of the tail between spring tong and insulator and to the fact that the tail is in line with the insulator in both vertical and horizontal planes. The conductor is passed round the insulator and "necked," then taking two turns on the turnbuckle, sufficient slack is pulled into the tail to allow it to be drawn sideways, which affords adequate operating space for the application of the binder free from all obstructions, e.g., chains from "Pul-lifts," slings, etc.

Another suggestion is the use of a heavy roller attachment to a bulldozer in place of the dozer blade for the purpose of giving "controlled pressure" rolling to stacked coal and by so getting maximum consolidation, minimize the risk of spontaneous combustion taking place in the coal stack. Proper consolidation at the sides and ends of a coal stack, where normally this is difficult to accomplish, can easily be obtained by the ability to lower the dozer arm with the roller attachment when rolling over the edge of the stack so the vehicle weight can be brought to bear

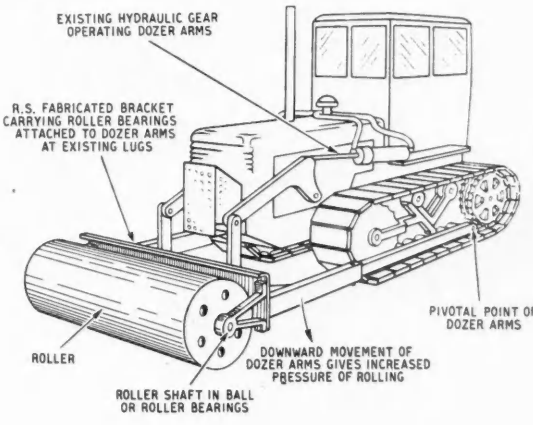




Conductor tensioning tool



Bulldozer modified for coal consolidation


EXISTING HYDRAULIC GEAR OPERATING DOZER ARMS
R.S. FABRICATED BRACKET CARRYING ROLLER BEARINGS ATTACHED TO DOZER ARMS AT EXISTING LUGS
PIVOTAL POINT OF DOZER ARMS
ROLLER
DOWNWARD MOVEMENT OF DOZER ARMS GIVES INCREASED PRESSURE OF ROLLING
ROLLER SHAFT IN BALL OR ROLLER BEARINGS

on the roller in addition to its own weight, thus giving what is termed " controlled pressure rolling."

The roller attachment consists simply of a steel of cast iron hollow roller equal in length to the blade of the dozer to which it is to fit and having bossed end plates rigidly fixed to a shaft which passes through the length of the roller and projects at each end.

These shaft ends fit into ball or roller bearings housed in two steel brackets which form part of a rolled steel fabricated frame having lug attachments identical with those of the dozer blade which the roller attachment replaces so that quick and easy interchanging of the two fittings can be made. (Two men can change the dozer blade for the roller attachment in 15 minutes.) The same pivot and fixing pins are used to secure either fitting so that the roller attachment is a single unit in itself just as is the dozer blade.

The very considerable pressure which the equipment can bring to bear uniformly on stacked coal enables maximum consolidation to be carried out over a wide area in the minimum of time so that each layer of coal dozed out over the stack area can be made sufficiently firm to permit vehicles carrying the next layer of coal to run over it without danger of sinking in. The equipment is claimed to give maximum consolidation to stacked coal, which means prevention of spontaneous combustion and the consequent saving of thousands of tons of coal nationally per annum. The equipment has secondary uses such as the consolidation of tipped ash for site " build up " and the maintenance of unfinished roadways.

The third suggestion of note is astonishingly simple and has earned awards of £70 for its originator. It was to take the neutral of an overhead supply lead-in direct to the meter, instead of via a neutral link, mounted beside the fuse, as at present. As the suggester pointed out, if two meters were to be mounted on the same board, or if looping to another point were required, then the neutral link would still be needed, but in the majority of cases it could be dispensed with. Neither of the national assessors could see why the link should be retained except in special cases. A photograph of a meter board, wired up using only a fuse and meter, printed in the " Suggestions Review " leads one to wonder whether a saving of at least 30 per cent could not now be made in the size of the meter board, and again, has no meter manufacturer considered moulding the line fuse unit into the meter case itself?

Italian Electrical Trade

Growth of Home Production

THE extensive use of water power has encouraged the growth in Italy of the industry for the manufacture of turbo-generators and transformers capable of supplying all the national needs, states Mr. E. J. Joint (H.M. Minister (Commercial) in Rome) in his report* on the economic and commercial conditions in Italy. Experience has not been so great in the case of thermal stations, many of which are small capacity stand-by plants for seasonal use.

The Italian industry produces most kinds of diesel engine generator sets, especially for industrial use. In such electrical equipment as rolling stock for the railway, tramway and trolley-bus systems it can hold its own against foreign goods. It has been aided since the war by the large Government orders arising out of reconstruction and as a result of large extensions to the electrification system. About 400 firms are members of the National Association of the Electrotechnical Industry, of which six each employ more than 3,000 workers. Production covers a complete range, from heavy plant to domestic apparatus, electronic equipment, X-ray and radio, signalling and control systems, and conductors and insulators. Italian products have a firm hold on the home market, but more attention is now being paid to export possibilities and in 1953 electrical plant and equipment was exported to the value of over 10 milliard lire (about £6 million), the most important destinations being Argentina, Greece, France and Brazil.

United Kingdom Prospects

Dealing with market possibilities for United Kingdom products in Italy, Mr. Joint says that the Italian household is rapidly becoming more mechanized and there is a good market for electrical labour-saving devices. There is an efficient local industry which is already well able to deal with the demand for such appliances as electric irons, heaters, fans and cookers. Electric refrigerators are already well established and increasingly becoming a standard part of kitchen equipment. In this field there is a good opening for the sale of sealed refrigerator units for inclusion in Italian made cabinets. The use of washing machines is on the increase and United Kingdom machines are already well established on the market. Although sales of domestic equipment are increasing the market is limited, the modest standard of living restricting the possibility of sales in many areas. To capture the available trade it is important to develop sales appeal, both by attractive finish and adequate publicity. An efficient servicing organization is also required. An appendix to Mr. Joint's report shows that imports from the United Kingdom in 1953 included telecommunications apparatus (923 million lire), electric motors and parts (533 million lire) and other electrical apparatus (1,405 million lire).

Water Power Developments

As a result of the scarcity of natural fuel, Italy has been forced to develop her resources of water power, but seasonal shortages are not as yet adequately met by thermal stations. To use the seasonal resources fully an extensive grid is desirable, although the cost of construction is high. A transmission line of 220 kV has been completed from Verona to the South via Naples. Mr. Joint refers to the link across the Strait of Messina (a description of which was published in our last issue). It is estimated that the total water resources available for the production of electricity amount to 55 milliard kWh, but all of this is not economically usable. Total production in 1953 reached 32 milliard kWh, an increase of 6 per cent over 1952 and approximately 115 per cent over the pre-war output. The development of thermal stations, previously confined to those centres where hydro-electric power was not always available, has continued as the economic limits of hydro-electric generation are being approached. Seasonal difficulties have encouraged owners of large plants (particularly in the metal industries) to develop their own thermal generators. The increasing availability of natural gas has also encouraged the construction of power stations using this fuel. The industry is operated by large private companies. Some of these have received considerable help from the State, and in some cases foreign financial interests are involved. The State Railways largely generate power for their own requirements and in view of their special needs (both regionally and seasonably) rely mostly on thermal stations.

* H.M. Stationery Office, 4s net.

JAPAN'S CABLE INDUSTRY*

Probable Drive to Recover Export Markets

THE Japanese electric wire and cable industry, which dates back to 1880, rapidly assumed full status in the wake of the development of electric lighting and telegraphy and telephony after the Sino-Japanese war of 1894-95. The production of power communication cables started at the beginning of this century. The industry's rapid development was due in large measure to the sharp expansion of the market for electric wire and cables brought about by the liberal State aid accorded to electric power companies. Again, the industry, as a major processer of copper, which Japan is fortunate enough to possess in relatively large quantities, was strongly supported by the copper producing interests. This fact distinguished the Japanese electric wire and cable industry from that of other countries where it developed as an accessory of the telecommunications industry and constituted a sector of the electrical machinery industry.

The first world war provided this industry, which had been dependent on the home market, with an opportunity to enter world markets. In the 1920's the industry succeeded in manufacturing high voltage power cables, submarine cables, steel reinforced aluminium cables, etc. However, as a consequence of the great economic depression which hit the country in 1929, a large number of firms went out of existence and the manufacture of electric wires and cables was concentrated in the hands of the powerful Zaibatsu combines. Stimulated by the development of South Manchuria and North China after Japan had invaded these territories in 1931, and by the growth of Japan's heavy industry, the wire and cable industry made great strides.

Owing to a shortage of copper and other materials, the industry's output dwindled during the second world war and the quality of this small output deteriorated to a marked degree. However, since the principal manufacturers suffered little war damage, the industry recovered rapidly after the war in response to the increasing rehabilitation demand. Expressed in metric tons of copper, sales rose from 52,800 in 1930 to 98,300 in 1937, but fell to 41,600 in 1946. Thereafter, a steady recovery set in, sales amounting to 59,114 in 1949, 73,413 in 1950, and 81,460 in 1951. The industry was unable to maintain this rate, and a decline to 75,591 tons and 74,326 tons took place in 1952 and 1953.

Production Structure

Although over 200 firms are at present engaged in the manufacture of electric wires and cables, output is concentrated in the hands of seven leading concerns, viz. Furukawa Denki Kogyo K.K., Sumitomo Denki Kogyo K.K., Fujikura Densen K.K., Showa Densen Denran K.K., K.K. Hitachi Seisakusho, Dainichi Densen K.K., and Nippon Densen K.K., which together account for about 70 per cent of Japan's output. Moreover, concentration of output in the hands of these leading firms tended to increase still further last year.

Lower demand since 1952 has led to a disappearance of small-scale makers (engaged chiefly in the production of rubber-insulated and cotton-covered wires) while execution of increased orders for communications cables and power cables (which are beyond the resources of small firms) has been concentrated in the hands of the large units. Apart from the seven leaders just mentioned, there are a few other firms which carry on an integrated production from copper melting to wire covering. All other manufacturers are engaged only in processing work with core wires being supplied by the large integrated concerns. The volume of core wire supplies by such firms in 1953 was 12,474 tons, i.e. only 15·6 per cent of the total annual output of 78,899 tons. Recently efforts have been made by the large integrated firms to bring into their fold efficient smaller manufacturers of covered wire so as to stabilize the sale of core wires.

Home demand is based chiefly on the electrification of the railway system, the further development of the electric power supply network, and the general improvement of the equipment of the machinery industry. Special procurement orders during the Korean war provided an important fillip.

As regards exports of electric wires and cables from Japan, a pre-war record was established in 1935 with about 26,000 tons. Since the bulk of the shipments went to Korea, Manchuria and China, the post-war loss of Japan's influence in these territories was the greatest single cause of the marked reduction of exports after the war. The trade revived in 1949 and there was a further expansion because of the Korean war, the 1950 figure totalling 17,000 tons, but since the turn of 1953, exports have dwindled again to about 2,000 tons. The introduction of the bonded warehouse system for electrolytic copper, adopted at the end of 1953, helped to step up exports somewhat, but they have never been more than 500-600 tons per month, or only about one-half of the monthly export volume registered in 1952.

The revival of a free metal market resulted in a lower international price level for electrolytic copper; however, the price of Japanese electrolytic copper remained above the world price. This factor made it difficult to secure export orders and led eventually to the severe decline referred to.

As for the future, there is a strong likelihood that domestic demand will remain stagnant for some time to come. In all probability, the weeding out of small manufacturers will continue, business being even more concentrated in the hands of the large concerns. Manufacturers will also endeavour to introduce new lines; in fact, to make good the technical backwardness due to the war years, the industry has already introduced commercial scale production of wires covered with p.v.c., nylon, synthetic rubbers etc. At present efforts are being made to turn out e.h.v. oil-filled cables and submarine cables for d.c. transmission.

A determined effort is also likely to be made to recapture export markets, particularly in the countries of East and South-East Asia; to this end, a powerful export association may be formed designed to eliminate unnecessary competition among manufacturers. Eventually, an accord may also be reached among manufacturers as regards production. These measures, combined with further technological progress, modernization of equipment and rationalization of production, may well result in a marked expansion of the present low level of exports.

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* Summarized from an article in the *Survey of Japanese Finance and Industry* (Vol. VI, No. 5) published by the Industrial Bank of Japan, Ltd.

Financial Section

STOCKS and SHARES

STOCK EXCHANGE markets will have been adjusting themselves, during the later part of this week, to the changes announced in the Budget. As a market factor, the latter is generally conceded this year to have had much of its thunder stolen by the more momentous matter of the forthcoming General Election. In that connection, there is some indication of current City opinion in the buoyancy of industrial share prices recorded in the accompanying price lists; the changes on this occasion cover the three weeks ending just before Budget day, and include many big advances. Another sign was the strengthening of quotations for the shares of the formerly nationalized steel companies. Their future is regarded as being closely concerned with the next General Election result.

C. A. Parsons Results

It would be difficult to find a dividend more conservative than the 10 per cent ordinary distribution which C. A. Parsons are making on account of 1954. This will involve the distribution of less than £200,000 net from a net surplus (after tax and the preference dividend) of £1,471,000. It is thus covered, on the basis of the preliminary profits statement, more than seven times over. The dividend represents an effective increase of 2½ per cent on last year's: the improvement in the net profit appears to be of the order of 80 per cent, after a tax charge which, relieved now of the excess profits levy, remains about the same at £1½ million. The immediate market reaction to last week's announcements was a rise of 3s 6d in the price of the £1 shares to 66s (the official quotation was 1s lower). The yield of only about 3 per cent is clearly related to the substantial earnings backing for the dividend.

L.E.W. Shares

The new £1 ordinary shares issued last month by London Electric Wire Co. & Smiths, which have been quoted recently at about 52s, will be available in allotment letter form, and free of transfer stamp duty, until 9th May. That is the last date by which the ordinary shareholders may renounce their rights to subscribe for the new shares at 47s 6d each, and the date also upon which the final call of 27s 6d must be paid. It will be remembered that at the time of this issue the directors estimated profits for 1954 in excess of the previous figures, and declared the intention of recommending a final dividend of 8¼ per cent, making a total of 12½ per cent, or 2½ per cent more (in effect) than before. The new shares will not participate in this final payment, but will rank for all subsequent distributions. Assuming the maintenance of a 12½ per cent dividend on the increased capital, the prospective yield

Three Weeks' Price Changes

Company or Board	Nom. Value	Middle price 18th April	Three Weeks' Rise or Fall	Dividend Previous	Dividend Last	Yield %	1955 Highest	1955 Lowest
Gilt-edged Stocks						£ s d		
Brit. Elec. 1968/73	100	89½	+1	3	3	3 7 0	94¾	86
Brit. Elec. 1974/77	100	88½	+1	3	3	3 7 9	93¾	85½
Brit. Elec. 1976/79	100	92½x.d.	+¾	3½	3½	3 15 8	98¾	91
Brit. Elec. 1974/79	100	103½	+1	4¼	4¼	4 2 3	109	100½
Overseas Electric Supply								
Calcutta Elec.	£1	22/6	+1/-	6†	6†	5 6 8†	22/6	20/9
East African Power	£1	21/6	+1/-	7	7	6 10 3	23/3	19/9
Nigerian Elec.	£1	23/6x.d.		10	10	8 10 3	27/-	22/6
Palestine Elec. "A"	£1	21/-	−1/-	Nil	Nil	—	22/9	21/-
Perak Hydro-Elec.	£1	18/-		6	10	11 2 3	21/-	17/9
Equipment and Manufacturing								
Aberdare Cables	5/-	13/-x.d.	+9d	12½	17½	6 14 6	13/9	11/-
Aerialite	1/-	6/-	+3d	88½	88½	7 7 3*	6/7	5/3
Allen, W. H.	£1	79/6		15	20	5 0 8	81/6	78/6
Aron Elec. Ord.	£1	57/6		20	15	5 4 4	62/-	55/6
Assoc. Elec. Ord.	£1	71/3	+6/3	11¼	14	3 18 10	74/3	61/3
Automatic Tel. & El.	£1	70/9	+9d	15	15	—	79/6	69/-
Babcock & Wilcox	£1	77/9	+4/-	18	12*	3 1 9	81/6	68/6
Baldwin, H. J.	2/-	4/9		20	20	8 8 6	5/4	4/4
Bakelite	10/-	30/-	+6d	12½	16	5 6 8	32/-	27/-
British Aluminium	£1	42/6	+4/-	10	12	5 13 0	43/9	35/3
B.I. Callender's	£1	49/-	+2/-	10	10	4 1 8	55/3	44/9
B.I. Callender's 6% Pref.	£1	25/-		6	6	4 16 0	26/6	24/-
British Thermostat	5/-	23/9	+1/3	35	27½*	—	27/3	22/6
British Vac. Cleaner	5/-	16/-x.d.		25	30	9 7 6	17/9	14/3
Brook Motors	10/-	41/3	+2/6	20	20*	—	42/9	39/9
Brush Ord.	5/-	8/6		6	10	5 17 9	9/6	7/7
Bulgin, A. F.	1/-	5/-x.d.		30	45	9 0 0	5/3	4/-
Burco	5/-	20/-	+6d	35	25*	6 5 0	23/-	19/6
Chloride El. Storage "A"	£1	65/9	+6/3	20	12½*	3 16 0	69/-	58/6
Clarke Chapman	£1	82/6	+5/-	20	20*	4 17 0	82/6	68/9
Cole, E. K.	5/-	20/-	+6d	25	27½	3 9 0*	24/6	18/3
Cossor, A. C.	5/-	9/6		10	10	5 5 3	11/3	8/9
Crabtree	10/-	31/3		17½	20	6 8 0	34/6	29/3
Crompton Parkinson Ord.	5/-	16/9	+6d	20	20	—	19/9	16/-
De La Rue	5/-	21/9	+9d	Nil	20	4 12 0	24/3	18/9
Decca	4/-	36/3	+3/9	35	56¼*	—	45/6	31/-
Desoutter	5/-	27/9	+6d	20	25	4 10 1	28/-	25/6
Dewhurst	2/-	7/6	+3d	19	24	6 8 0	8/3	7/3
Dictograph Tel.	2/-	7/-	+3d	20	20	5 14 3	7/6	6/6
Dubilier Condenser	1/-	5/-	+6d	25	25	—	5/7	3/10
E.M.I.	10/-	29/-	−6d	8	10	3 9 0	37/-	25/3
Electrical Components	5/-	15/3		20	20	6 11 3	17/6	15/3
Elec. Construction	£1	33/9	+1/3	15	15	4 9 0*	37/3	31/6
Enfield Cable Ord.	£1	21/3		5	Nil	Nil	25/3	20/-
English Electric	£1	63/9		10	12½	3 18 6	69/3	54/3
English Electric 3¾% Pref.	£1	15/6		3¾	3¾	4 16 9	16/9	14/9
Ericsson Tel.	5/-	37/6	+1/-	25†	20†*	2 13 4†	37/6	29/-
Ever Ready	5/-	24/-	+1/3	35	40	—	25/-	22/3
Falk Stadelmann	£1	46/3		15	15	6 9 9	50/6	43/9
G.E.C. Ord.	£1	56/3	+3/9	11½	12½	4 9 0	61/9	51/3
G.E.C. 6½% Pref.	£1	27/-		6½	6½	4 16 3	28/4	23/6
General Cables	5/-	15/9	−6d	20	30	9 10 6	17/-	15/9
Greenwood & Batley	£1	55/-		17½	17½	6 7 3	57/-	54/6
Hackbridge Cable	5/-	16/9	+1/-	20	20	5 19 5	16/9	14/-
Hackbridge & Hewittic	5/-	24/6		20	25	5 2 0	28/9	23/9
Hall Tel. Acc.	10/-	13/3		10	10	7 11 0	13/3	11/-
Heatrae	2/-	4/6	+3d	12½	12½	5 11 0	5/9	4/3
Henley's	10/-	20/-	+9d	10½	10½	5 5 0	20/6	17/-
Holophane	5/-	17/6		20	25	7 2 9	19/9	16/-

* After capital bonus. † Free of income tax.

The above quotations are based upon middle prices in the Stock Exchange Daily Official List.

on the new shares is approximately 4¾ per cent.

Brush "Convertibles"

In view of the interest in Brush Group 5s shares since the publication of the 1954 results, attention may be called to the fact that the company's 6 per cent convertible £1 preference shares occasionally come on offer at about 29s 6d. The yield is not much over 4 per cent, and they are liable to repayment at 21s after 1963; the main attraction is, however, the right to convert each £1 of the preference into four 5s ordinary stock units, at a premium of 1s each. The opportunity to do so arises twice a year, in June and December, until 1963. The shares have been quoted recently at about 8s 6d. A recovery in net earnings last year from £404,000 to £538,000 enabled the company to restore the rate of the ordinary dividend to 10 per cent.

...in Electrical Investments

Company or Board	Nom. Value	Middle price 18th April	Three Weeks' Rise or Fall	Dividend Previous	Dividend Last	Yield %	1955 High-est	1955 Low-est
Equipment and Manufacturing—continued.						£ s d		
Hoover	5/-	48/6	+4/-	45	70	7 4 4	52/6	40/-
I.C.I.	£1	43/-	+1/6	13	15	3 9 9*	45/3	38/3
Intl. Combustion	5/-	26/-	+1/-	20	25	4 16 2	30/6	23/6
Johnson & Phillips	£1	48/9	+2/6	15	15	6 3 0	52/6	45/-
Lancashire Dynamo	£1	62/6	+6/3	14	15	4 16 0	62/6	55/3
Laurence, Scott	5/-	16/3	+6d	15	20	3 1 6*	16/9	14/6
Lister, R. A.	£1	33/6	+2/-	12	9·3*	5 11 3	38/3	30/6
London Elec. Wire	£1	52/6	+1/6	10	12½	4 15 3	61/-	50/6
Lucas, J.	£1	43/9	+1/3	10·8	7½*	3 8 7	50/6	41/6
Marryat & Scott	2/-	9/6		22½	25	5 5 3	10/4	9/6
Mather & Platt	£1	61/6	+3/6	15	13·4*	—	61/6	48/-
Metal Industries	£1	35/6	+3/3	12	9	5 1 5	38/-	30/-
Midland Elec. Mfg.	£1	46/3	+1/3	15	10*	4 6 6	46/6	44/-
Morphy-Richards	4/-	27/-		40	35*	5 3 9	31/9	27/-
Murex	£1	56/3	+4/3	15	15	5 6 8	57/-	49/3
Newman Ind.	2/-	2/9		10	10	—	3/6	2/4
Oldham & Son	1/-	3/6		17½	17½	5 0 0	3/6	2/10
Parnall (Yate)	5/-	11/6	+1/3	6	8	3 9 6	13/2	7/3
Parsons, C. A.	£1	65/-	+6/d	7½	10	3 1 6	69/6	56/-
Plessey	10/-	66/9	+4/3	30	20*	3 0 0	76/6	57/6
Pye Deferred	5/-	35/-	+3/9	20	20*	2 17 3	40/6	28/6
Revo	10/-	13/-		27½	9*	6 18 6	15/3	12/6
Reyrolle	£1	95/-	+2/6	13¾	15	3 3 3	106/3	89/-
Rheostatic	4/-	17/3x.d.	+1/3	20	22½	5 4 3	17/3	14/9
Richardsons Westgarth	5/-	14/3	+6d	15	15*	5 5 3	15/-	11/-
Scottish Cables	4/-	20/3	+3d	20	27½	5 8 6	22/6	19/6
Smith (England), S.	4/-	16/6	+6d	15	17½*	4 4 9	20/-	15/-
Southern Areas	£1	31/3	+3/3	6	7½	4 16 0	34/9	27/6
Strand Elec.	5/-	9/9		17½	17½	8 19 6	9/9	8/6
Sturtevant	5/-	24/-	+1/6	18·1†	18·9*†	—	27/6	21/-
Sun. Elec.	£1	33/9		15	15	8 17 9	34/6	33/9
Switchgear & Cowans	5/-	15/-x.d.		10	20	6 13 4	15/6	11/-
Taylor Tunnicliff	5/-	13/3		12½	15	5 13 3	14/-	11/3
T.C.C.	10/-	47/-	+9d	30	25*	5 6 6	47/-	41/-
T.C. & M.	£1	37/6		10	8½*	4 10 9	40/9	35/-
Telephone Mfg.	5/-	9/6	+6d	10	10	5 5 3	10/6	9/3
Thorn Elec.	5/-	35/-	+6/3	12½	20	2 17 3	37/6	26/3
Thornycroft	£1	40/-	+1/-	15	15	—	44/-	34/6
Tube Investments	£1	77/6		15	17½	4 10 3	85/9	72/6
Vactric	5/-	15/-	+1/3	Nil	10	—	18/9	12/-
Veritys	5/-	8/-	+1/-	10	12½	7 16 3	9/3	7/3
Walsall Conduits	4/-	50/-		70	70	—	55/-	50/-
Ward & Goldstone	5/-	38/3	+1/3	45	50	—	43/3	37/6
Watford	2/-	7/-		22½	25	7 2 9	7/1	6/3
Westinghouse Brake	£1	95/-	+1/3	16	18	3 16 0	101/9	82/-
West, Allen	5/-	14/-	+1/6d	17½	15*	5 7 3	15/6	8/-
Wolf Electric	5/-	19/-		17½	20	5 5 3	19/3	16/1
Trusts, Transport and Communications								
Anglo-Am Tel.:								
A. Ord.	100	78½		6	6	7 12 9	88	78½
Ord.	100	50		3¾	3¾	7 17 6	54½	50
Anglo-Portuguese	£1	25/-x.d.	+3/-	8	8	6 8 0	25/-	21/-
Brit. Elec. Traction:								
Def. Ord.	5/-	22/-	+2/-	35	50	—	24/3	19/6
Cable & Wireless:								
Ord.	£1	42/6		9	10	4 14 3	48/9	39/6
4% Loan	100	97½		4	4	4 2 0	100	92
Calcutta Trams	£1	25/-	+4/-	2½†	6†	4 16 0†	25/-	20/-
Cape Elec. Trams	£1	17/6	+6d	5½	7	8 0 0	17/6	16/6
Marconi Marine	£1	37/6	+2/6	10	10	5 6 8	37/6	33/-
Oriental Tel Ord.	£1	99/6	−1/-	16	16	—	102/6	96/6
Telephone Props.	£1	82/6	+2/6	—	20	4 17 0	90/6	80/6
Telephone Rentals	5/-	11/6	+1/6	10	10	4 7 0	11/6	9/3

Earnings and Dividends

The following table summarizes some of the electrical company results published during the first quarter of the year, and compares them with the previous results. Earnings figures are based on each company's net surplus after all charges, and are expressed as a gross percentage of the present capital. Dividends are shown with the previous rates in parenthesis. Figures have been adjusted for scrip issues distributed between the two years:—

Company	Earned % 1953	Earned % 1954	Div. %
A.E.I.	45	61	15 (11¼)
B. Peebles	68	103	25 (12½)
B.V.C.	—	112	30 (25)
Bulgin	53	87	45 (30)
Cable & W.	12	14	10 (9)
Clarke C.	56	82	20 (13·3)
Desoutter	61	113	25 (20)
English Electric	27	39	12½ (10)
Ericsson	43	56	20 (12½)
Hoover	106	193	70 (45)
Int. Comb.	43	60	25 (20)
Mather & P.	37	39	13·4 (9)
M.E.M.	29	38	10 (7½)
Reyrolle	80	96	15 (13¾)
Switchgear & C.	13	26	20 (10)
Taylor T.	45	48	15 (12½)

"Earnings Cover"

The above table serves to illustrate a matter which receives close attention these days in the valuation of individual ordinary shares; namely, the extent by which the amount paid out in the ordinary dividend is covered by the net surplus of profits available either for distribution or for retention in the business. In the case, for instance, of A.E.I., the 15 per cent dividend is shown to have slightly more than fourfold cover by the earnings of 61 per cent. In other words, three-quarters of the 1954 net profits, after all charges, are being ploughed back. In this connection it is noteworthy that although every dividend in the table shows an increase on the previous year's rate, in more than half the cases the amount so paid out was still less than one-third of the sum disposable.

Television in North Scotland

The B.B.C. announces that it has acquired a site 680ft above sea level at Rosemarkie, 12 miles north of Inverness, for a television transmitter which is expected to be ready for service by the end of next year.

REPORTS and DIVIDENDS

A. Reyrolle & Co., Ltd., reports a consolidated trading profit for 1954 of £3,195,725, as compared with £3,111,067 for the preceding year, which with other income makes £3,379,991. After meeting all charges including £1,519,294 for taxation, the net profit is £1,647,017 (against £1,159,105). Stores and work in progress reserve receives £300,000, general reserve £535,520, development expenditure account £300,000 and renewals account £250,000. It is proposed to pay a final dividend on the ordinary stock of 8¾ per cent, making 15 per cent for the year. For the previous year the total dividend was 13¾ per cent, of which the final dividend of 7½ per cent was paid on increased capital. In addition there was a special distribution of 2½ per cent out of a surplus realized by the sale of an investment. The balance carried forward is £489,348 (against £533,777 brought in).

In his statement which accompanies the report and accounts, Sir Claude Gibb (chairman) says that whilst the orders from abroad showed a welcome improvement, those received from the home market, although satisfactory, did not reach the very high figure of the previous year. There was a modest reduction in the orders for some of the smaller switchgear, but this will assist in achieving shorter delivery periods. Over the whole range of their products the volume of orders on the books shows a healthy position.

The development of nuclear fission will not lessen the need for switchgear of the kind used in the conventional power stations, and the main switchgear being installed in the prototype nuclear power station at Calder Hall is of their manufacture. The prospect of the heat liberated by nuclear fission completely superseding the traditional fuels is remote. Its important role will be to fill the gap between the resources of the traditional fuels and the growing fuel needs of civilization in the years ahead. The coal and petroleum industries are among their important customers and they supplied to them flameproof equipment and the more usual forms of distribution switchgear. This, coupled with the fact that the Central Electricity Authority and the Electricity Boards are their principal customers in Great Britain, means that with their range of products they are well placed to meet the foreseeable changes in the fuel situation.

Full-scale testing with the new equipment at the research station has been of inestimable value to the research and design staff in improving the quality of their switchgear, more especially for the very high voltages now coming into general use. Sir Claude refers to the lack of young entrants to industry with adequate scientific knowledge and the company's scheme for training young engineers. During the year under review a substantial extension was made to the shop for the assembly of e.h.v. switchgear and this is already fully occupied with work in hand. Land has been purchased on which a new shop is to be built for the manufacture of the lighter engineering components of their switchgear.

Switchgear & Cowans, Ltd.—The accounts for 1954 were abstracted in our issue of 25th March. In his annual statement, Mr. J. L. Rowbotham (chairman) says that a fire at the premises of Richard Whiffen, Ltd., the subsidiary company manufacturing insulation, affected the output of the main switchgear factory until the end of July, but from then onwards, with the insulation factory rehoused and with reconditioned and new plant coming into production, matters improved and at the end of the year a rate of output about 10 per cent above 1953 was realized. The results for the year show a substantial improvement on those of 1953.

Further expansion of productive capacity and widening of the range of products has necessitated additional investment in debtors and stock and work-in-progress, amounting to £145,000, and this has led to a limited amount of borrowing from the bank. This situation is restricting any further increase in output, as due to shortage of capital it is not possible to provide additional productive capacity at the No. 2 factory site. Ways and means of decreasing the figure for stock and work-in-progress are being studied and it is hoped by speeding up batch production times to reduce the amount of capital in this investment and provide funds for the reduction of the bank overdraft and for an increase in the productive capacity. The order book for the main company is satisfactory and the order position of the subsidiary companies is better than it has been for some years.

The Telegraph Condenser Co., Ltd.—The main figures in the accounts for 1954 were given in our issue of 11th March. In his statement which accompanies the report and accounts Mr. P. V. Hunter (chairman) says that during the year under review the Acton and Bathgate factories achieved the highest output in quantity of components ever recorded. The need for additional manufacturing space has become a matter of urgency and arrangements have been made for a substantial addition to the Bathgate factory. The research and development organization has been further strengthened and enlarged. The company is actively engaged in the development and manufacture of printed wiring and components, a method of eliminating the use of individual wires for joining components to form an electrical circuit. The turnover exceeded that of the previous year, whilst the quantity of components sold was substantially greater. Valuable new business has been obtained both at home and abroad.

A. H. Hunt (Capacitors), Ltd.—The report and accounts for 1954 now issued confirm the preliminary figures given in our issue of 1st April.

In his review of the year, Mr. S. H. Brewell (chairman) says that competition continued to be keen in all markets, but in spite of rising manufacturing costs, they were able to meet such competition by a substantial increase in turnover. Both home and exports markets continued to expand and considerable plans have been made to increase the manufacturing facilities to enable them to hold their position in the world markets. With regard to Hunt Capacitors (Canada), Ltd., the new company operated jointly by A. H. Hunt (Capacitors) and the Canadian Marconi Co., the products have been well received and it is hoped that by the end of 1955, considerable progress will have been made.

The technical side of the business continues to demand a large amount of attention and with the field of electronics extending daily into almost every class of industry, the laboratory facilities have had to be expanded in an endeavour to keep pace with the technical demands made on them.

Blaw Knox, Ltd.—The accounts for 1954 show a trading profit of £428,128, as compared with £407,114 for 1953. This figure includes provisions of £34,000 no longer necessary. After meeting all charges, including £196,061 for taxation, the net profit is £185,319 (against £182,838). It is proposed to pay a final ordinary dividend of 20 per cent, making 30 per cent for the year and to carry forward £319,990 (against £332,354 brought in). It is proposed to capitalize £49,465 and to distribute to shareholders 197,860 ordinary 5s shares, the allotment to be equivalent to 18½ per cent of the number of ordinary shares now held by them.

In his statement, Mr. J. M. Wallace (chairman) says that severe competition has affected some of the departments. The construction machinery department (judged by earnings alone) did not have quite such a good year as in 1953, but the tower department had one of the best years in the history of the company. During the year important development work was carried out which resulted in the introduction of new products. The volume of orders in hand is at a satisfactory level and they continue to receive valuable orders from home and abroad.

Brook Motors, Ltd., has declared an interim dividend of 5 per cent on the 1,141,364 ordinary shares of 10s each.

(*Continued on page 695*)

This compares with an interim dividend last year of 5 per cent on 998,693 ordinary shares of 10s each.

The Rheostatic Co., Ltd.—The financial results for 1954 were given in our issue of 25th March.

In his review of the past year's activities, Mr. M. J. Gartside (chairman and managing director) says that the turnover increased in the home and export markets. The company has a full order book and there is a considerable world-wide demand for Satchwell thermostats and instruments for use in domestic electric water heaters and cookers and for the control of oil and gas burners, coal stokers and central heating equipment. Despite increasing output, the company is unable to satisfy completely demands from customers at home and abroad. An extension of the main works has been completed to provide increased space for research and development work. Work has also been started on extensions to premises at Frimley, Surrey, but it will be early in 1956 before such extensions become productive. Referring to the current year, restrictions on hire purchase may have a retarding effect on that part of the business which relates to the domestic heating market, but the overall demand for Satchwell temperature controls for all purposes shows no signs of falling.

Mr. Gartside refers to proposals for increasing the authorized capital and the distribution of bonus shares to ordinary stockholders to be presented at an extraordinary meeting which will follow the annual meeting on 6th May. It is proposed to increase the authorized capital from £400,000 to £650,000 by the creation of additional ordinary shares, and that reserves (£74,313 share premium account and £64,287 part of general reserve) be capitalized and applied in paying up in full 693,000 bonus shares of 4s each, which will be distributed to ordinary stockholders in the proportion of three new shares for every five 4s stock units held.

C. A. Parsons & Co., Ltd., report a profit for 1954 of £1,484,298, as compared with £807,862 for 1953. The figure is struck after deducting £1,542,250 for taxation. It is proposed to pay a final dividend of 6¼ per cent, making 10 per cent for the year on capital trebled by a 100 per cent scrip issue and a 100 per cent rights issue. For 1953 an interim dividend of 6¼ per cent was paid before the capital issues and a final dividend of 4⅜ per cent on the present capital.

Thorn Electrical Industries, Ltd., proposes to raise further capital to the extent of about £1,250,000, to be used for certain extensions and additions to its plant and factories. It is proposed to raise this finance in the near future by an issue of "A" ordinary shares, carrying limited or no voting rights, which will be offered by way of rights to ordinary shareholders: the date of the offer and the price will depend upon market conditions. It is also proposed to capitalize £528,750 of reserves, and to issue credited as fully paid-up 2,115,000 5s ordinary shares, identical with the existing ordinary shares, on a one-for-one basis to ordinary shareholders. The directors further propose that the preference share capital structure shall be simplified by the merging of the existing 6 per cent cumulative and 5 per cent second cumulative classes so as to form one class of 5 per cent cumulative preference shares.

Proposals for compensating the holders of the existing 6 per cent cumulative preference shares for the loss of their priority and higher rate of dividend will be laid before ordinary shareholders. In addition, the directors consider that the borrowing powers exercisable by them should be increased, and a meeting of holders of 5½ per cent unsecured loan stock, 1959-64, is being convened to secure their consent, in return for which it is proposed that the rate of interest on the stock shall be 5¾ per cent as from 1st July next and that none of the stock shall be repayable (except by purchase) until 1964. C.I.C. consent to the above issues has been received. An extraordinary general meeting and separate meetings of the holders of all classes of capital are being convened for the purpose of passing the resolutions necessary to give effect to all the above proposals.

The London Electric Wire Co. & Smiths, Ltd.—The profit for 1954, before taxation, is £1,035,212, as compared with £1,076,520 for 1953, to which is added £75,000 provision for diminution in value of investments no longer required, making £1,110,212. Taxation requires £509,534, and the group net balance is £600,678 (against £530,772). General reserve receives £375,000. It is proposed to pay a final ordinary dividend of 8¾ per cent, making 12½ per cent for the year, and to carry forward £492,757 (against £479,815 brought in).

Renold Chains, Ltd., has acquired, for cash, the whole of the share capital of the Anchor Chain Co., Ltd.

Murphy Radio, Ltd., proposes to pay a dividend for 1954 of 20 per cent (against 15 per cent). The net profit for the year, after charging £227,964 for taxation, is £182,317 (against £145,338).

Parkinson & Cowan, Ltd.—The consolidated trading profit for 1954 is £383,167, as compared with £330,221 for the previous year, and after meeting all charges, including £93,293 for taxation, the net balance is £89,517 (against £144,739, which included £64,330 adjustments relating to previous years). It is proposed to pay an ordinary dividend for the year of 9 per cent (unchanged).

In his statement, Sir George Jessel, Bt. (chairman) says that manufacture of electricity meters and instruments has been grouped together in the London precision-component factory and this combined division operates under the title of Parkinson & Cowan Instruments. The division has a full order book for 1955.

New Companies

Coldrator, Ltd.—Registered 1st April. Capital £100. Electrical and mechanical engineers, manufacturers of and dealers in mechanical and electrical machinery and apparatus, etc. Regd. office: Crown House, Aldwych, W.C.2.

Premier Electric Heaters, Ltd.—Registered 1st April. Capital £100. Regd. office: Crown House, Aldwych, W.C.2.

Jurd & Paine, Ltd.—Registered 3rd March. Capital £1,500. To acquire the business of electrical contractors and retailers carried on by S. J. W. Jurd and V. J. W. Paine at the Electrical Shop, High Street, Beaulieu, Hants. Directors: S. J. W. Jurd and V. J. W. Paine. Regd. office: The Electrical Shop, High Street, Beaulieu, Hants.

Electrical Services (Lincs), Ltd.—Registered 3rd March. Capital £1,000. Electrical and mechanical engineers and consultants, hire - purchase financiers in connection with the sale and purchase of radio sets, etc. Directors: E. M. Wright, R. G. Coman and H. Taylor. Regd. office: 47, Hamilton Road, Scunthorpe, Lincs.

Dawson, Forino & Co., Ltd.—Registered in Edinburgh 1st February. Capital £2,500. Manufacturers, erectors, installers, repairers and maintainers of television, radio and radar equipment, etc. Directors: W. Dawson and A. K. Dawson.

Burco Dean, Ltd.—Registered 29th March. Capital £100. To acquire the whole or any part of the shares of Burco, Ltd., and W. H. Dean & Son, Ltd., and carry on business as an investment company, etc. Power is also taken to carry on business as manufacturers and vendors of gas and electric washing machines and wash boilers, etc. The first directors are not named. Regd. office: Waterside Mill, Rose Grove, Burnley.

General & Electrical Stores (Burton), Ltd.—Registered 5th March. Capital £5,000. General and electrical engineers, manufacturers of and dealers in engineers' materials, components, tools, apparatus, appliances, ironmongers, hardware dealers, manufacturers of and dealers in cooking and heating apparatus, electrical fittings, domestic goods, etc. Directors: Mrs. Margaret H. Beazley and J. S. V. Beazley. Regd. office: 123, Moor Street, Burton-on-Trent.

Vac Electrical Products (Blackburn), Ltd.—Registered 12th March. Capital £3,000. To acquire the business of an electrical products dealer carried on by G. Ainley, at Market Street Lane,

Blackburn, and at 15-17, Drury Hill, Nottingham, as Vac Electrical Products, etc. Directors: G. Ainley and Mrs. Florence Ainley. Regd. office: 3-3a, Market Street Lane, Blackburn.

Smith & Lamerton, Ltd.—Registered 11th March. Capital £4,000. To acquire the business of an electrical engineer and contractor carried on by A. Smith at Gloucester, as Smith & Lamerton, etc. Directors: A. Smith (permanent) and W. H. Wait. Regd. office: 3, St. Aldate Street, Gloucester.

Baxters Electrical, Ltd.—Registered 31st March. Capital £8,000. Electrical engineers and contractors, radio and television engineers, etc. Directors: F. S. Baxter and L. Baxter. Regd. office: 4, Beastfair, Pontefract, Yorks.

Tymes Electric (Tottenham), Ltd.—Registered 30th March. Capital £2,000. To acquire the business of electrical dealers now carried on by R. F. Oakhill and H. C. Green at 692, High Road, Tottenham, as Tymes Electric Utilities. Directors: R. F. Oakhill and H. C. Green. Regd. office: 692, High Road, Tottenham, N.17.

C.G. Electrics, Ltd.—Registered 31st March. Capital £500. Electricians, radio and electrical engineers, etc. Directors: C. G. Robertson and Mrs. Elizabeth M. Robertson. Solicitors: Gerald Wilson & Bell, Guildford, Surrey.

Emis of Birmingham, Ltd.—Registered 31st March. Capital £500. Electricians, electrical contractors, etc. Directors: G. A. Wood and S. G. Bibb. Regd. office: 29, Hart Road, Erdington, Birmingham.

H. J. Olive (Rugby), Ltd.—Registered 31st March. Capital £1,000. Electronic, radio and television engineers, etc. Directors: H. J. Olive and J. P. Buckingham. Regd. office: 70, Bath Street, Rugby.

J. Russell Electronics, Ltd.—Registered 4th March. Capital £1,000. To undertake and carry out research and experimental work of all kinds, to design, invent, exploit, develop, manufacture and deal in electronic, nucleonic, radar and all kinds of radiological, telecommunication, television and electrical apparatus, etc. The first directors are not named. Regd. office: Solwhite Buildings, Walton Road, West Molesey, Surrey.

Portable Electric Tools, Ltd.—Registered 15th March. Capital £10,000. Importers, exporters, distributors and manufacturers of and dealers in merchandise of all kinds, etc. D. R. Welch is the first director. Regd. office: 59, Sloane Street, S.W.1.

Electric Motors (Fulham), Ltd.—Registered 10th March. Capital £5,000. Electrical and electronic engineers and contractors, manufacturers of and dealers in dynamos, motors and motor control gear, armatures, magnetos, etc. Directors: G. W. Sutton and Ursula M. Sutton. Regd. office: 72, Farm Lane, Fulham, S.W.6.

H. D. Culley & Co., Ltd.—Registered 11th March. Capital £2,000. Electrical contractors, civil and electrical engineers, builders, etc. Directors: H. D. Culley, R. L. Culley, A. V. Culley and R. Culley. Regd. office: 6, D'Arcy Drive, Kenton, Harrow.

Liquidations

W. Skewes & Co., Ltd., electrical engineers.—Winding up voluntarily. Liquidator, Mr. G. R. Postlethwaite, Midland Bank Chambers, High Street, Doncaster, appointed 31st March.

N.V. Electrical & Musical Instruments, Ltd.—Winding up voluntarily. Liquidator, Mr. E. S. Hall, Harborne House, 49, Poplar Road, Solihull, Birmingham.

Bankruptcies

J. S. Morris, 295, Stockport Road, Cheadle Heath, Stockport, electrical contractor.—Receiving order made 4th April on a creditor's petition.

J. F. Husband, 22, Metham Street, Lenton, Notts, electrical trade representative, lately electrical contractor.—Last day for receiving proofs for dividend 23rd April. Trustee, Mr. E. C. Stimpson, 27, Regent Street, Park Row, Nottingham, Official Receiver.

NEXT WEEK'S EVENTS

Organizers of electrical functions are advised to make use of the "Electrical Review" clearing house, Room 231, Dorset House, Stamford Street, London, S.E.1, to ascertain that proposed dates do not clash with others already arranged

Sunday, 24th April, to Tuesday, 26th April

PAIGNTON.—Redcliffe Hotel. Association of Electrical Machinery Trades. Annual convention.

Monday, 25th April

BIRMINGHAM.—James Watt Institute, Great Charles Street, 6 p.m. I.E.E. South Midland Radio Group. Annual general meeting, followed by "A Transatlantic Telephone Cable," by Sir W. Gordon Radley, Dr. M. J. Kelly, G. W. Gilman and R. J. Halsey.

BOURNEMOUTH.—Grand Hotel, 8.15 p.m. A.S.E.E. Bournemouth Branch. "Some Interesting Fan Applications," by R. C. Dick.

LEICESTER.—E.M.E.B., Charles Street, 6 p.m. I.E.S. Leicester Centre. "Lamps and Lighting for Inspection," by H. E. Bellchambers.

LONDON.—Savoy Place, 6.30 p.m. I.E.E. London Students' Section. "The Taming of Graduates," by J. M. Armstrong.

Monday, 25th April, to Thursday, 28th April

LONDON.—At the New Horticultural Hall, Westminster. Physical Society Exhibition of Scientific Instruments and Apparatus.

Tuesday, 26th April

EDINBURGH.—11, Atholl Crescent, 7.30 p.m. Edinburgh Electrical Society. Annual general meeting, followed by a film show.

GLASGOW.—425, Sauchiehall Street, 7 p.m. Institution of Heating and Ventilating Engineers, Scottish Branch. Annual general meeting; "Radiant Heating," by F. R. L. White.

LEEDS.—1, Whitehall Road, 6.30 p.m. I.E.E. North Midland Students' Section. "Electric Contracting," by D. Pitts.

LIVERPOOL.—Radiant House, Bold Street, 6.30 p.m. Institution of Heating and Ventilating Engineers, Liverpool & District Branch. Annual general meeting.

LONDON.—At the Royal Institution, Albemarle Street, W.1, 8 p.m. Electrical Association for Women. Soiree: Address by Sir Lawrence Bragg on "Thirty Years of Electrical Progress."

The Institute, 85, Minories, 5.30 p.m. Institute of Marine Engineers. Annual general meeting.

May Fair Hotel. Institution of Chemical Engineers, 11 a.m. Annual meeting, followed by president's address. 7 for 7.30 p.m. Annual dinner.

Tuesday, 26th April, to Friday, 29th April

LONDON.—Caxton Hall, S.W.1. British Electrical Development Association. Annual Conference. Friday's proceedings and luncheon at the Connaught Rooms, W.C.2.

Wednesday, 27th April

CARDIFF.—College of Technology, Cathays Park, 6.30 p.m. British Institution of Radio Engineers, South Wales Section. "Some Technical Prob'ems in Sound and Television Broadcasting," by Dr. K. R. Sturley.

EDGBASTON.—Golf Club. Birmingham Electric Club. Golf Competition.

ISLE OF GRAIN.—I.E.E. London Students' Section. Visit to B.P., Kent Oil Refinery, at 2 p.m.

LONDON.—Savoy Place, 5.30 p.m. I.E.E. Supply Section. "Automatic Circuit Reclosers," by G. F. Peirson, A. H. Pollard and N. Care.

At the Royal Society of Arts, John Adam Street, W.C.2, 7 p.m. Institution of Electronics. "The Transistor as a Circuit Element," by F. Oakes.

At the Institution of Civil Engineers, Great George Street, S.W.1, 5.30 p.m. Institute of Fuel. "Fuel and Power Research in Britain," by Dr. W. I. Jones.

Connaught Rooms, W.C.2. Electrical Association for Women. Annual Conference.

Connaught Rooms, W.C.2, 12.30 for 12.55 p.m. Batti-Wallahs' Society. Luncheon. Speaker, Dr. Foxwell.

School of Hygiene & Tropical Medicine, Keppel Street, 6.30 p.m. British Institution of Radio Engineers, London Section. "Suppressed Aerials for the Aircraft h.f. Band," by K. J. Coppin.

Wednesday, 27th April, and Thursday, 28th April

LONDON.—4, Grosvenor Gardens, S.W.1. Iron and Steel Institute. Annual general meeting.

Thursday, 28th April

LONDON.—Savoy Place, 5.30 p.m. Institution of Electrical Engineers. Extra meeting. "The Adhesion of Electric Locomotives," by Dr. H. I. Andrews.

At the Institution of Mechanical Engineers, Birdcage Walk, 6 p.m. Institution of Heating and Ventilating Engineers. Annual general meeting and Presidential Address.

Friday, 29th April

BIRMINGHAM.—James Watt Institute, Great Charles Street, 6.30 p.m. I.E.E. South Midland Education Discussion Circle. "Teaching Matrices to Part-Time Students," by Dr. W. E. Lewis.

LONDON.—Horseshoe Hotel, Tottenham Court Road, W.1, 6 for 7 p.m. Edmundsons Group reunion.

Saturday, 30th April

LONDON.—I.E.E. Supply Section. Visit to Lime Grove Television Studios and White City Television Centre.

Duke of York's Headquarters, Chelsea, S.W.3, 7 p.m. London Sapper reunion.

NOTTINGHAM.—A.S.E.E. Nottingham Branch. Visit to a power station.

NEW PATENTS

Electrical Specifications Recently Published

The numbers under which the specifications will be printed and abridged are given in parentheses. Copies of any specification (2s 8d each including postage) will be obtainable after 25th May from the Patent Office, 25, Southampton Buildings, London, W.C.2.

1950

24537. E.M.P. Electric, Ltd.—Electric surge arrestors. 23rd November, 1951. (730634.)

28240. Roevae Air Extractors (1952), Ltd.—Electric toasting appliances. 14th February, 1952. (730636.)

1951

10558. Siemens Bros. & Co., Ltd.—Electrical impedance networks and their use for gain control and attenuation equalization in telecommunication systems. 2nd May, 1952. (730372.)

10797. General Electric Co., Ltd., Cooper, A. D., and Nelson, E. H.—Electric circuit arrangements for operating gas or vapour filled electric discharge lamps. 1st August, 1952. (730373.)

15536. Postmaster General.—Output control circuits for electrical transmission networks. 22nd October, 1952. (730558.)

17657. Clark, C. W.—Electric tumbler switches. 22nd August, 1952. (730377.)

23121. Pirelli-General Cable Works, Ltd., Ashford, B. O., and Burt, W.—Paper insulation for electric cables. 14th August, 1952. (730378.)

27928. Johnson & Phillips, Ltd., and Stevens, C. J. H.—Sealing glands. 23rd September, 1952. (730716.)

1952

471. Reyrolle & Co., Ltd., A.—Electric synchronizing arrangements. 2nd April, 1953. (730645.)

844. Cole, Ltd., E. K., and Hutchings, E. L.—Moving coil loudspeakers. 12th January, 1953. (730381.)

5524. Baker & Co., Inc.—Heat resistant multi-metallic thermostat elements. 3rd March, 1952. (730385.)

6410. Allis-Chalmers Manufacturing Co. —Arc chutes in electric circuit interrupters. 12th March, 1952. (730546.)

7382. Standard Telephones & Cables, Ltd.—Timing indicator valve. 21st March, 1952. (730548.)

7664. Parsons & Co., Ltd., C. A.—Combustion apparatus and especially such systems as are applicable to control of combustion in gas turbine plant, industrial furnaces or the like. 25th March, 1952. (730571.)

7804. Edison Swan Electric Co., Ltd.—Snap-action electric switches. 23rd March, 1953. (730387.)

8030. Baker Platinum, Ltd.—Electrolytic cells. 20th March, 1953. Cognate application 25634, 13th October, 1952. (730649.)

13102. Licencia Talalmanyokat Ertekesito Vallalat.—Automatic control equipments for engine-generator sets. 23rd May, 1952. (730651.)

14097. Associated Electrical Industries, Ltd.—Apparatus for accelerating electrically charged particles. 4th May, 1953. (730719.)

15728. Mole-Richardson (England), Ltd. —Electric light projectors particularly for subaqueous use. 25th March, 1953. (730588.)

16300. Siemens Bros. & Co., Ltd.—Electrically operated register assemblies. 19th June, 1953. (730391.)

16691. Dowty Equipment, Ltd.—Hand-operated electric selector switches. 2nd October, 1953. (730720.)

17542. Plessey Co., Ltd.—Electrically operated indicator. 21st September, 1953. (730591.)

18228. British Thomson-Houston Co., Ltd.—Constant current circuits for operating electric-discharge lamps. 18th July, 1952. (730656.)

19047. Jackson Electric Stove Co., Ltd.—Electric cooking ovens. 3rd July, 1953. (730657.)

19822. Arista, W. R. P. Schulz Ges.—Electric baking, roasting and cooking apparatus. 6th August, 1952. (730721.)

19918. Simmonds & Stokes (Niphan), Ltd.—Electric switches interlocked with components in their circuit. 23rd July, 1953. (730395.)

21059. National Research Development Corporation.—Transistor oscillator circuits. 4th August, 1953. (730597.)

21115. Cinema-Television, Ltd.—Electrical timing arrangements. 21st August, 1953. (730598.)

23049. Electric & Musical Industries, Ltd.—Manufacture of grids for electron discharge devices. 21st August, 1953. (730483.)

23357. Telephone Manufacturing Co., Ltd.—Snap-action electric switches. 25th August, 1953. (730660.)

26652. Minister of Supply.—Circuits for generating electric pulse code signals. 23rd October, 1953. (730667.)

26930. London Electrical Manufacturing Co., Ltd.—Hermetically sealed cased condensers and other electrical components. 18th August, 1953. (730606.)

27122. General Electric Co., Ltd., Allard, L. S., and Hill, R. T. J.—Cathode-ray tubes. 28th October, 1953. (730607.)

29845. Elliott Bros. (London), Ltd.—Delay circuits for electronic digital computing apparatus. 25th November, 1953. (730672.)

31647. Cowlishaw, Ltd., J. C.—Adjustable electric contact thermometers. 14th December, 1953. (730414.)

31962. Automata.—Electromagnetic adjustable drives. 17th December, 1952. (730677.)

32621. General Electric Co.—Contact clips for mounting on printed circular panels. 23rd December, 1952. (730416.)

1953

1113. General Electric Co.—Gas-blast electric circuit breakers employing arc chutes. 14th January, 1953. (730611.)

2936. FKG F. Kesselring Geratebau Akt.-Ges.—A.c. switching arrangements. 2nd February, 1953. (730612.)

3839. Standard Telephones & Cables, Ltd. (International Standard Electric Corporation).—Electron-discharge device output coupler. 11th February, 1953. (730681.)

3875. General Electric Co., Ltd.—Electrical contacts. 11th February, 1953. (730615.)

4707. Waugh, A. K.—Electric immersion heaters. 11th February, 1954. (730616.)

8073. British Thomson-Houston Co., Ltd. —Lamp sealing and exhausting machines. 24th March, 1953. (730739.)

8203. Nettle Accessories, Ltd., and Revington, D.—Electrical fittings. 31st December, 1953. (730428.)

9763. Hackbridge & Hewittic Electric Co., Ltd., and Peters, H. J.—Mercury arc rectifier apparatus. 14th December, 1953. (730743.)

9828. Marconi's Wireless Telegraph Co., Ltd.—Piezo-electric crystal oscillators and resonators. 17th March, 1954. (730688.)

10026. Rheostatic Co., Ltd.—Devices for protecting furnaces at times of flame failure. 13th April, 1953. (730619.)

10178. British Insulated Callender's Cables, Ltd.—Means for supporting overhead electric traction conductors. 13th April, 1954. (730689.)

12101. General Motors Corporation.—Electric rotary step-by-step switch. 1st May, 1953. (730621.)

12640. Compagnie Générale de Télégraphie sans Fil.—Wave guide and discharge tube arrangements. 6th May, 1953. (730693.)

14869. Croydon Engineering Co., Ltd.—Alternators. 25th May, 1954. (730512.)

16105. Allis-Chalmers Manufacturing Co. —Dynamo-electric machine having a ventilation shield in the air gap. 11th June, 1953. (730515.)

16717. General Electric Co.—Insulating panels. 17th June, 1953. (730699.)

19378. Siemens & Halske Akt.-Ges.—Non-chattering contact arrangements for relays. 13th June, 1953. (730704.)

20575. Ford Motor Co., Ltd.—Thermal electrical current interrupting devices. 24th July, 1953. (730441.)

21862. Radio Corporation of America.—Transmission of colour television and sound signals. 7th August, 1953. (730758.)

24493. English Electric Co., Ltd.—Panel-mounting cases for electrical apparatus. 28th March, 1952. (730452.)

24717. Cinch Manufacturing Corporation. —Holders for thermionic valves, electrical plugs or the like having projecting terminal prongs. 7th September, 1953. (730762.)

27428. General Electric Co.—Adjustable reference voltage units. 6th October, 1953. (730457.)

35394. Robbins & Bradley, Ltd., and Robbins, D. H.—Snap-action electric switches. 19th December, 1953. (730460.)

35521. General Electric Co.—Stationary electric induction apparatus embodying moulded sealed casings. 21st December, 1953. (730769.)

1954

6476 and 6477. E.M.P. Electric, Ltd.—Electric surge arrestors. 23rd November, 1951. (730709/10.)

15524. Allis-Chalmers Manufacturing Co.—Arc chutes in electric circuit interrupters. 12th March, 1952. (730538.)

TRADE MARKS

APPLICATIONS have been made for the registration of the following trade marks. Objections may be entered up to 6th May:—

DACORE. No. 699,599, Class 9. Electric cables and insulated electric wires.—J. Day & Co. (Derby Works), Ltd., Harrow Manor Way, Abbey Wood, London, S.E.2.

TELEFUNKEN (design). No. 718,626, Class 9. Scientific and electrical apparatus and instruments; apparatus and instruments for use in physics; and radio and television transmitting and receiving apparatus, apparatus and instruments for use in navigation, low frequency amplifiers, microphones, loudspeakers, electronic valves, etc.—Telefunken Ges., Berlin, Germany. Address for service, c/o Baron & Warren, 16, Kensington Square, London, W.8.

TELOTALK. No. B732,358, Class 9. Electrical instruments to be used in conjunction with telephone instruments for the purpose of sound amplification.—S. E. Opperman, Ltd., Stuart Works, Stirling Corner, Boreham Wood, Herts.

MASSICORE. No. B734,625, Class 9. Electrice core transformers. — Savage Transformers, Ltd.

JETWELD. No. 738,887, Class 9. Electrodes for electric welding.—Lincoln Electric Co., Ltd., 45, Broadwater Road, Welwyn Garden City, Herts.

MARQUISA. No. 739,010, Class 9. Radio, television and telegraphic instruments and apparatus, etc.; electric batteries; and cases for electric torches or pocket lamps.—Vidor, Ltd., West Street, Erith, Kent.

ELMED. No. 738,633, Class 10. Electromedical apparatus. — Electro-Medical Hire, Ltd., 74, New Caendish Street, London, W.1.

CONTRACT INFORMATION

Accepted Tenders and Prospective Electrical Work

CONTRACTS OPEN

Where "Contracts Open" are advertised in our "Official Notices" section the date of the issue is given in parentheses.

Australia.—16th May. Electricity Commission of New South Wales. Remote supervisory control apparatus. (E.S.B. 8067/55. Ten/13381.)*

Belfast.—28th April. Northern Ireland Hospitals Authority. Electrical installation in Ards Hospital, Newtownards, Co. Down, and Lurgan and Portadown Hospital, Lurgan, Co. Armagh. Chief Engineer, Victory Buildings, 44/46, Queen Street.

26th May. Corporation Electricity Department. 11·8 kV and l.v. transformers for Belfast West power station. (See this issue.)

Second extension to power station. (See this issue.)

Belgian Congo.—6th May. Ministry of Colonies, Brussels. Cable and cable accessories. (E.S.B. 8207/55. Ten/13402.)*

Bristol.—Cossham and Frenchay Hospital Management Committee invites applications from contractors for supplying electrical stores and refrigerator services for the year 1955-56.

Bury.—30th April. Borough Corporation. Street lighting equipment. (See this issue.)

Canada.—18th May. Saskatchewan Power Corporation. One 66 MW steam turbo-alternator set. (C.R.E. 4034/55. Ten/13385.)*

Costa Rica.—3rd May. Institute Costarricense de Electricidad, San Jose. Two 7,500 kW and two 600 kW transformers. (E.S.B. 8031/55. Ten/13380.)*

East Riding.—3rd May. County Council. Electrical work in home for aged persons at Driffield. County architect, County Hall, Beverley.

Egypt.—16th June. Ministry of Public Works, Cairo. Five electrically-driven floating pumping stations. (E.S.B. 7230/55. Ten/13327.)* 27th June. Generating station for the Government Oil Refinery, Suez. (E.S.B. 8085/55. Ten/13389.)*

Folkestone.—7th May. Borough Council. Street lighting equipment. (See this issue.)

India.—17th May. India Store Department. Lighthouse radar equipment, shore establishment. (See this issue.)

1st June. Electricity Department, Damodar Valley Corporation. Three 20 MVA synchronous condensers and auxiliary equipment. (E.S.B. 7672/55. Ten/13322.)*

Iraq.—3rd May. Directorate-General of Municipalities, Baghdad. Five 100 kVA electric transformers. (E.S.B. 7710/55. Ten/13332.)* 6,600 V cables and 660 V boxes for Amara. (E.S.B. 7709/55. Ten/13331.)* 10th May. 660 V submarine cable and boxes for Samawa. (E.S.B. 7708/55. Ten/13330.)* 15th June. 250-300 kW, 440-200 V diesel generating plant for Khanaqin power station. (E.S.B. 7707/55. Ten/13329.)*

Peterborough.—30th April. City Council. Electrical installations in houses (36) and flats (16), on the Walton estate. (See this issue.)

Portuguese West Africa.—27th May. Department of Ports, Railways and Transport, Luanda. Radio and electrical equipment and instruments. (E.S.B. 8027/55. Ten/13403.)*

Sedgefield (Durham).—R.D.C. Electrical installations in 40 houses at Ferryhill. Housing architect, Council Offices.

South Africa.—5th May. Union Tender and Supplies Board. Radio valves, antennæ relays, transformers, etc. (E.S.B. 7593/55. Ten/13306.)*

11th May. Stores Department, South African Railways. Insulated cable. (E.S.B. 7993/55. Ten/13370.)* 12th May. Telephone cable and insulated cable. (E.S.B. 7988 and 7994/55. Ten/13365 and 13371.)* Electric lamps. (E.S.B. 7992/55. Ten/13369.)*

20th May. Durban Corporation. Telephone switchboard spare parts. (E.S.B. 7458/55. Ten/13314.)*

United States.—20th May. Corps of Engineers, U.S. Army, Seattle, Washington. 15 kV bus, breakers and generator earthing equipment for Chief Joseph Dam, Columbia River, Washington. (E.S.B. 7613/55. Ten/13320.)*

Uruguay.—3rd May. Administracion Nacional de Combustibles Alcohol y Portland Casilla de Correo 1090, Montevideo. 600 kW, 6,300 V switchboard panel and power switch. (E.S.B. 7774/55. Ten/13343.)* 13th May. Starting switches for 220 V motors with auto-transformers and voltage transformers. (E.S.B. 8130/55. Ten/13400.)*

16th May. Administracion de Ferrocarilles del Estado. Telephone trunk line material. (E.S.B. 8025/55. Ten/13386.)*

Whiteabbey (Co. Antrim).—29th April. Northern Ireland Tuberculosis Authority. Electric lighting and call system for Whiteabbey Hospital. A. W. Gordon Holt, consulting engineer, 74, South Parade, Belfast.

Wick.—Burgh Council. Street lighting installation. (See this issue.)

* Specifications may be inspected at the Export Services Branch, Board of Trade, Lacon House, Theobald's Road, London, W.C.1 (Chancery 4411; extension 769).

ORDERS PLACED

Coventry.—Education Committee. Electrical installation work at Coundon Court Secondary School (£4,404).—Foden Electrical Services.

London.—L.C.C. Renewal and improvement of electrical installation at Robert Montefiore Primary School, Stepney (£2,771). —Thorpe & Thorpe, Ltd. Renewal and improvement of electrical installations at Clipstone Street annexe to Barrett Street Technical College, St. Marylebone, and schoolkeeper's house (£2,586).—Electrical Contracting Co. Renewal and improvement of electrical installation at Deansfield Primary School, Eltham (£4,069).—Powerlite Electrical Installations, Ltd.

WORK IN PROSPECT

Particulars of new works and building schemes for the use of electrical installation contractors and traders. Publication in this section is no guarantee that electrical work is definitely included. Alleged inaccuracies should be reported to the Editors.

Acton.—Works, Colville Road; Dougall's Meters, Ltd., Osborne Works, Bollo Road, London, W.3.

Bath.—Bus station, Manvers Street; Bristol Tramways & Carriage Co., Ltd., 1-3, St. Augustine's Place, Bristol.

Beckenham.—Flats (172), Crystal Palace Park Road estate; J. Dove, borough surveyor, Town Hall.

Birmingham.—Multiple stores, Meadway shopping site, Kents Moat estate; F. W. Woolworth & Co., Ltd., 1, New Bond Street, London, W.1.

Brentford.—Offices; Thames Steam Tug & Lighterage Co., Ltd., 41, High Street.

Bulwell (Notts).—Blenheim Secondary School (£193,786); R. M. Finch, city surveyor, Guildhall, Nottingham.

Carlisle.—Houses (210), Morton estate; L. J. A. Stow, city engineer, 18, Fisher Street.

Chester-le-Street.—Houses on 15-acre site at North Lodge; R.D.C. surveyor, Union Offices.

Colwyn Bay.—Town hall, municipal offices, assembly hall, etc., on site in Queen's Gardens; N. S. Jeffrey, borough surveyor, Town Hall.

Darlington.—Houses (54), Branksome estate; E. A. Tornbohm, borough architect.

Desborough.—Secondary modern school; county architect, Northampton.

Dumbarton.—Houses and flats (248); Scottish Special Housing Association, Ltd., 15-21, Palmerston Place, Edinburgh.

Dundee.—New mill (£500,000); Jute Industries, Ltd., Meadow Place Buildings.

Feltham.—Municipal offices, assembly hall, etc., Hanworth Road (£400,000); J. L. Grimshaw, U.D.C. surveyor, 13, Hanworth Road.

Grimsby.—Works, King Edward Street; North Lincolnshire Tyre Co., Ltd., Catherine Street.

Halstead.—Houses (50), Park Fields estate; U.D.C. surveyor, The Red House.

Holyhead.—Dwellings (64), Richmond Hill and High Terrace; U.D.C. surveyor.

Hounslow.—Boiler house at the West Middlesex Hospital (£160,000) for North West Metropolitan Regional Hospital Board; Architects' Department, Sheffield Road Hospital, Kingsway, London, W.C.2.

Ilford.—Public baths and wash-houses, Fulwell Cross; borough engineer.

Factories (2), Ley Street; Fuller, Hall & Foulsham, engineers, 212, High Holborn, London, W.C.1.

Kidderminster.—Houses (205), and bungalows (40) for aged persons, on the Habberley estate; J. G. Stewart, borough surveyor, 110, Mill Street.

Leicester.—Bungalows (40) and flats (24) on New Parks estate and redevelopment of Wharf Street area, including dwellings (740), shops, etc.; J. H. Lloyd Owen, city architect, 7, Newarke Street.

London.—Cinema, Barking Road, Canning Town; Circuits Management Association, Ltd., 5, Bainbridge Road, W.C.1.

Newcastle-on-Tyne.—County secondary schools at Alnwick (£88,700), North Sunderland (£46,750) and Morpeth (£103,150); county architect, County Hall.

North Riding.—Four police houses at Richmond, one at Scorton and one at Barton; county architect, County Hall, Northallerton.

Oundle.—Canteen at county modern school (£8,000); county architect, Northampton.

Oxford.—Office block and stores; J. E. Billings & Co., Ltd., 20, Canal Street.

Peterlee.—Social club (£40,000); British Legion.

Plymouth.—Workshops, stores and offices; Rediffusion (Plymouth), Ltd., 34, Mutley Plain.

Shrewsbury.—County administrative centre near The Column, for Salop C.C.; county architect, Column House, London Road.

Sittingbourne and Milton.—Houses (86). North Court estate; U.D.C. surveyor, Central Avenue, Sittingbourne.

Wallsend.—Extensions to factory; Victor Products, Ltd.

Factory, G. Angus & Co., Ltd., Newcastle; S. W. Milburn & Partners, The Esplanade, Sunderland.

York.—Shops and offices, Coney Street; Saxone Shoe Co., Ltd., 89, Titchfield Street, Kilmarnock.

Houses (100), Chapel Fields estate; city architect.

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